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THE DEMENY CHRONOPHOTOGRAPHIC PROJECTION APPARATUS.

APROPOS of chronophotography, we have already had occasion to speak several times of the labors of Mr. G. Demeny, assistant to Dr. Marey at the Laboratory of Physiology. As long ago as 1891 we saw at Mr. Demeny's some projections of figures simulating the motions of animal life and that were obtained by means of an apparatus that we have already described.

Strips of sensitized film from 60 to 90 feet in length were not in existence at that epoch, and, in order to make a projection of some little duration, it was necessary to employ some makeshift. The images taken by the chronophotographic apparatus upon a strip 4 or 5 yards in length were printed as positives upon a glass disk sensitized with chloride of silver, and it was by means of this disk that the projection was made. The number of images was necessarily limited, and, since the diameter of the disk could not practically exceed 20 inches, about forty or fifty images were printed upon its circumference, according to the subject.

It was necessary, besides, that the motion represented should form a complete cycle capable of beginning again indefinitely. In certain cases, for the study of jumping, racing dancing, fencing, play of the features, and a host of other motions, this apparatus is quite adequate, and will still be able to render great services. But the advent of the long strips of sensitized film that are now manufactured has induced the inventor to so modify the apparatus as to render it reversible, that is to say, adapted for the taking of images in long series and for projecting them. He has preserved the principle of the eccentric, but has placed the latter exterior to the bobbin, in the circuit of the film. Moreover, he has added a toothed roller designed for obtaining a perfect register of the images, the film, to this effect, being perforated at the edges. We believe that it was Mr. Reynaud who was the first to apply this system of registering. This he did in his very ingenious optical theater, which gave the illusion of motion in scenes of long duration obtained through successive images projected upon a screen; but photography did not avail him, and he preferred to draw, with his own hand, the series of images that he needed for the pantomimes that he composed.

Mr. Demeny's new apparatus employs strips of any length whatever, but, up to the present, the longest that have been used are 115 feet. This gives about a thousand images of the dimensions adopted by the inventor, say $1\frac{1}{2} \times 1\frac{3}{4}$ inch. This wide surface of the images has an immense advantage from the view point of projection, since, with the electric light, it permits of making enlargements that may reach 16 feet in height. If one be content with a screen of ordinary dimensions, the oxyhydrogen light will suffice and the apparatus be easy to install anywhere. We represent herewith a complete installation for operating in a house in which there is neither gas nor electricity (Fig. 1, No. 1). The cylinder of oxygen, T, is placed under the table and connected by a rubber tube with the etheric blowpipe, L, placed in the lantern. The latter is provided with the ordinary lens, called a condenser, in front of which is placed a small reservoir of water, N, designed for absorbing a portion of the calorific rays, so that they may not too greatly heat the film, which, it must not be forgotten, is of celluloid, a very inflammable material.

At the other extremity of the table stands the chronophotographic projector, which carries the film wound around its bobbins. The lantern is so regulated that the luminous rays shall fall exactly upon the aperture that the image passes, behind the objective, O. After the focusing has been effected, all that is to be done is to turn the winch, M. At P and P are seen guides that serve to put the films that have just passed in their normal direction. It is, in fact, the last image projected that is the first to present itself upon the bobbin that has served for the winding during the projection, and were it utilized thus for another exhibition, the scene represented would pass the wrong way. It is necessary, moreover, to take precautions against the images presenting themselves upside down; so the guides are indispensable accessories during an exhibition, and this is why the inventor has judged it proper to fix them upon the table.

As well known, the principle of all projection apparatus of this kind consists in arresting the film for an instant at the moment at which it is uncovered by the shutter. The process employed to this effect by Mr. Demeny is very simple and has the advantage of not damaging the film, which may thus be used for a very long time. It is shown in the diagram figured herewith (No. 2, Fig. 1). Upon coming from the bobbin, the film passes over a guide, S, and then over a rod, D, mounted eccentrically. Thence it goes to the toothed roller, C, designed for registering the images, and then reaches the magazine, B. The mechanism is entirely inclosed in a box (Fig. 2) and the shutter disk (not represented) is situated on the other side of the aperture, F. Beneath the bobbin, A, there is a rubber roller, E, mounted upon a spring in such a way that it shall bear against the film whatever be the thickness of the winding upon the bobbin. It is this roller, E, that, moved by a gear of toothed wheels, causes the film to unwind in a continuous manner and thus prepares work for the eccentric rod, D. The latter, therefore, pulls upon a portion of the film already unwound, but does not strain it. The film, passing under the guide, S, passes between two velvet lined frames, H and T, that are provided with an aperture, F. It is upon making its exit thence and passing over the guide, S', that the film is taken by the rod, D, then runs over the toothed roller, C, and finally over the bobbin, B. All these parts, inclusive of the shutter, are interdependent and are connected by gear wheels set in motion by the winch, M. None of them has a jerky motion, and no mass in motion comes to a standstill. All the parts of the mechanism have uniform rotary motions, and the stoppage of the film is prepared for by a graduated diminution of the velocity; and so, too, the starting is effected without any abruptness.

One of the great advantages of this apparatus is that it permits of utilizing for a very long time such positive films as have not much commercial value. In Fig. 3 we reproduce a few images of a strip made especially for the new spectacular drama at the Chatelet Theater. This strip is 115 feet in length and embraces a thousand images, each of which is colored by hand. It produces a very beautiful effect. The negative was obtained with the same apparatus. It sufficed to change the objective and place a sensitized film upon the bobbin, A. The developing is effected much more easily than might be thought. It is the printing of the positive that presents the greatest difficulty, because the negative shrinks slightly in drying, and it is necessary to see that, despite this, every image transferred to the positive strip shall, at the time of the projection, pass exactly at the same place where the negative was obtained. A special machine for insensibly rectifying the position of the images had, therefore, to be devised for the printing of the positives.

All apparatus that are pretty well conceived as regards mechanism and pretty well constructed may give good results; but, among those patented the last year, few operate properly, and this is due especially (aside from their construction, which is not always faultless) to the very principle of stoppage. Herein lies the whole secret of such apparatus as operate well, and it is to these that is reserved in the future the exploitation of projections of figures in animate motion.—La Nature.

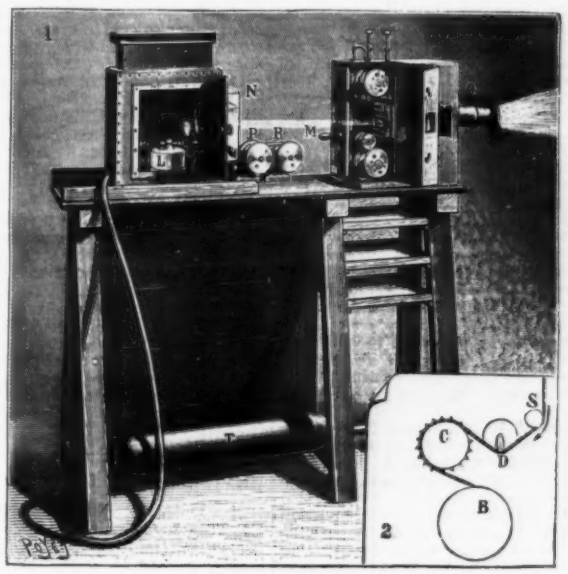


FIG. 1.—No. 1, The Demeny Projection Apparatus Arranged for Use Without Electricity or Gas. No. 2, Arrangement for Stopping the Strip of Film.

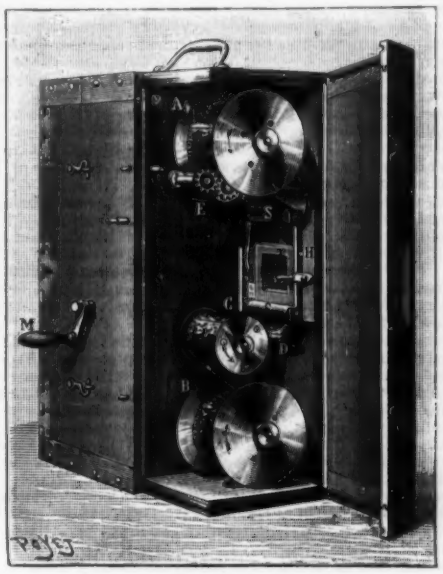


FIG. 2.—Interior View of Mr. Demeny's Reversible Projection Apparatus.

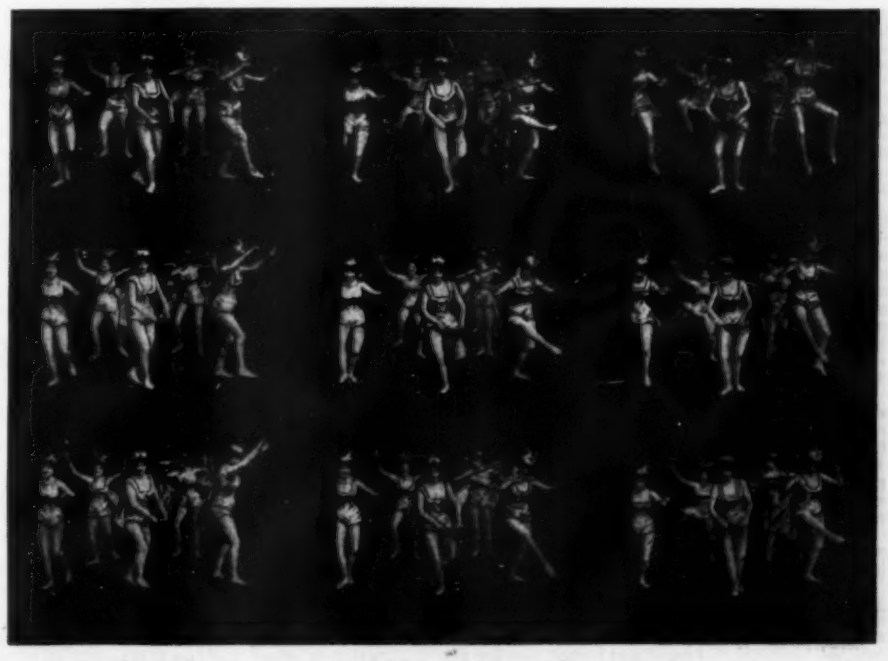


FIG. 3.—Figures of Actual Size from a Strip of Film 115 Feet in Length.

THE CHEMISTRY AND MECHANICS OF PLOWING.*

THIS subject, if followed in all its ramifications, covers nearly the entire course in agricultural chemistry, as well as a short treatise upon simple mechanics. Even vegetable physiology must be partially noticed, since the grand and primary object of plowing is to produce such conditions in the soil as shall conduce to the most rapid development of the cultivated plants in a given time.

In the hour allotted, however, only a few salient points can be noted, and these will be reviewed with great haste. There are two series of ever active forces in nature, the one constructive, the other destructive. They operate alike upon the three great kingdoms, mineral, vegetable and animal. These forces are gravity, heat, water—alone, as a vapor, liquid or solid—water charged with carbonic acid, oxygen of the air, chemical affinity, vitality and ferments. The latter may be regarded as a low order of vitality.

These forces have produced all of the changes on the earth's surface, and are still acting with undiminished intensity, causing transformations in the natural spectacular drama daily unrolling before the gaze of observing humanity. The internal heat of the earth, the deposition by moving water of rock material, subsequently solidified or crystallized by pressure, and other causes are constantly engaged in the process of rock making. As soon as the rock appears, whether of igneous or aqueous origin, the destructive forces begin the work of disintegration, preparatory for the support of vegetable life. First a few lichens, then mosses, then grasses and weeds, and finally shrubs and trees. A more or less complete disintegration of the rock, as observed by the unaided eye, is finally presented to the envious inspection of the prospective settler. While this disintegration, in situ, is occurring, the falling rains and moving waters are busy in transporting, assorting and depositing much of this disintegrated material at lower levels, and finally we will have large areas of alluvial soils encroaching upon the ocean's domain, and enlarging the territory of cultivable soils. As soon as these layers of alluvial material are super-imposed the one above the other to produce sufficient pressure, rock making again begins, and if undisturbed, incipient shales, slates, sandstones, etc., will ultimately be produced. This transformation is first exemplified in the hardpan which occurs underneath nearly every soil which is cultivated with shallow implements.

With these preliminary remarks it will doubtless be apparent to many of you that the first and primary object of breaking soil is to arrest this tendency to rock making, to open up the first twelve or eighteen inches of the soil to the disintegrating influences of air, water and vegetable matter. The character and size of the crops grown also determine the rate of disintegration, the larger and deeper the roots penetrate, the more effective they become in soil improvement. To secure the growth of plants with large and deep roots the soil must be deeply broken and stirred, for in this soil its roots must penetrate and live. It is their home, and easy permeability and a free access of air are absolutely essential for the full growth of roots of all kinds of plants. Again, the presence of air and the freedom of movement of water through the soil are also essential conditions for the elaboration of plant food from the rock dust which makes up the bulk of all soils. Here, too, we realize the presence of the ever acting forces of construction and destruction. "By ceaseless action all that is subsists," and the soluble plant food of to-day if not utilized at once by the growing plant is quickly resolved into insoluble forms or washed out by excessive rains. The amount of soluble food available at any one time is determined largely, as I will presently show, by "tilth."

Another object in breaking or inverting soil is to destroy weeds or grasses, and thus relieve it of the foulness which an excess of vegetable growth always produces. Breaking land is, therefore, a cleansing process. But another object in breaking land is to control moisture. If the lands are inclined to be water sobbed, they are usually thrown into high ridges, thus exposing the largest surface possible, with bare deep middles, insuring increased evaporation from lower depths and furnishing surface channels for the escape of flood water in times of excessive rains. Evaporation is a cooling process, and no soil can be made warm and fit for rapid growth of plants which contains an excess of moisture. Therefore, breaking is often resorted to to relieve the soil of abundant moisture, to produce heat and warmth necessary for plant vigor, and to permit the free circulation of air which is necessary for growth of roots and for the chemical reactions which must evolve soluble plant food. If, on the other hand, our lands are disposed to be droughty, barely affording enough water for a maximum crop, the reverse treatment is resorted to. The soil is now broken flat, each furrow is lapped upon the preceding one, forming a continuous blanket six or eight inches deep, so as to prevent the rapid evaporation which the nature of the soil would otherwise accomplish.

In this way such soils are kept moist. With soils of an intermediate character, such treatment should be given as will insure the most desirable quantities of moisture and heat needed for maximum growth. Soils vary largely in their capacity for moisture. The soils of Audubon Park, when saturated, will carry 51 per cent. of their weight in water without dripping; while those on this station (Calhoun) will barely hold 20 per cent. of their weight. It has been shown that the soils of the former are too dry to furnish the needed moisture to growing plants when they contain 12 per cent. of water; while the latter will successfully sustain plants down to 1¼ or 2 per cent. of their weight in water. These differences are due to the different percentages of clay, silt and sand which these soils contain. The larger the percentage of clay, the greater the capacity of holding water. Vice versa, the larger the proportion of sand, particularly coarse sand, the less its capacity for water. Since an excess as well as a deficiency of water is to be avoided, true loams (mixtures of sand and clay) are therefore better adapted to most of the crops grown. It has been found that 50 to 60 per cent. of the water holding capacity of every soil is the amount best adapted to rapid growth.

So much for the physics, the chemistry and the geology of breaking soils.

If this work has been intelligently performed, subsequent planting and cultivation are simple processes. If the process of breaking has been badly performed, then subsequent cultivation must be directed not only to cultivation proper, but to the securement of tilth; that is, obtaining the best conditions for the growth of crops.

Tilth, however, should be always obtained before planting, if possible, and then the after cultivation is purely one of culture, that is of the maintenance of tilth.

Unfortunately, such a happy condition does not often prevail with our farmers. It is too frequently the case that furrows hastily thrown together form the receptacle for our seed, and after the plant is up it is permitted to contend for mastery with weeds and grass until the latter promises success, when a desperate effort is made with turning plows, shovels and hoes to bury and annihilate the latter, and the cultivated plant, left alone in the occupation of the soil, is yet stunted, and surrounded by environments which will not conduce to the most rapid growth and development. Alas! cultivation is too often regarded as a process of destruction of weeds and grass, and is resorted to only for such purposes.

But cultivation should have no such object in view. It is true that our variable seasons will occasionally fill our fields with grass and weeds in spite of our efforts, and when filled must be removed by plow and hoe; yet it is the universal experience of every planter that the crop is never improved by such treatment. It is simply a necessary evil, often brought about by neglect or over cropping, but sometimes by such an extremely wet season as to defy human effort to prevent it. True cultivation should look only to the preservation of tilth which a proper preparation of the soil has established. It involves only two principles, the maintenance of the most rapid rate of nitrification and other chemical changes, and the conservation of the proper amount of moisture. Nitrogen is the most costly of the ingredients of plant food. It is also the most fugitive. It is derived chiefly from organic matter, which by a process of oxidation is converted into nitric acid. The salts of nitric acid are extremely soluble, and if not utilized at once by growing plants are washed out by heavy rains. Hence there is a gradual development of nitric acid during the period of growth of plants, and the process by which this oxidation of organic matter into nitric acid is accomplished is called nitrification.

This oxidation is going on in every fertile soil, and when stopped, even though the soil may be rich in vegetable matter containing nitrogen, the plants thereon must also stop their growth. What is necessary for nitrification?

(1) Organic matter containing nitrogen; (2) a certain amount of moisture; (3) a free access of air; (4) a certain temperature; (5) a mild alkali, with which the nitric acid can combine, when formed; (6) the presence of minute microscopic organisms or ferments.

With these conditions fully maintained nitrification is most rapid and effective, and the growth of plants is just in proportion to its rate. It can therefore be readily seen how cultivation tends to maintain the proper conditions for rapid nitrification. Many beneficial effects of cultivation can now be easily explained. We cultivate shallow, because such a process not only prevents destruction of roots of the plants, an evil always to be avoided, but also because nitrification takes place in the upper layers of the soil, and by the act of cultivation the ferment is well scattered. Again, the temperature at which fermentation is most active is about 90° to 110°, and this temperature obtains in the upper layers of the soil. The action of the ferment is suspended at or about 50° and 150°. It is destroyed by high heat and electricity; hence, when lightning strikes a soil, nothing will grow where it struck for some time afterward.

The presence in small quantities of lime highly favors nitrification. Moisture in excessive quantities excludes the air and suspends the vital activities of the ferment; hence the necessity of drainage. The absence of moisture is equally as objectionable, and here the second object of cultivation promotes the first.

From these considerations it will be seen that frequent cultivations, provided no roots are cut, are favorable to rapid nitrification. Soils cultivated daily produce better than the same soils cultivated weekly, and the latter better than those cultivated less frequently.

Besides the beneficial effects of rapid nitrification, other chemical changes of great practical value are induced by shallow and frequent cultivation. The soil is a great laboratory, and the chemical changes taking place there are complex and continuous, and frequent stirrings accelerate these changes and give increased available plant food. One practice must be emphasized here as both wise and expedient, i. e., of breaking the crust after every rain, to let in fresh portions of air and to aid nitrification, but under no circumstances should it be done while soil is wet, since this destroys rather than aids the ferment.

The second object in cultivation is to conserve the moisture. On the approach of a drought, cultivators should be run very shallow and almost continuously. In this way the thin layer of earth removed from the great mass of soil is laid as a mulch on the surface, and the continuous upward movement of the water through the soil into the air is checked just below the surface, and the roots of the plant can then appropriate it. The continuity of capillary pores is broken and the water heretofore passing into the air is arrested just below the surface, and is conserved for use of the plant. Hence cultivate continuously in dry weather. One other point—finely divided soils have the power (varying according to character from 1·5 to 23 per cent.) of absorbing hygroscopic moisture from the air, a not insignificant property in a prolonged drought with heavy dews at night. These are reasons why we plow. Now what do we do it with? All instruments used for working the ground and producing tilth, and classified as plows, may be divided into four classes: Plows proper, for breaking, inversion of soil, subsoiling, etc.; hand and horse hoes, for the destruction of grass and weeds; cultivators, which simply stir the soil for nitrification or conservation of moisture; and fourth, harrows and rollers.

The plow is an ancient implement. The Egyptians had an iron pointed share, but no colter or wheels. The Greeks added wheels to their iron pointed shares. The early Saxons added the colter to the wheels and iron pointed shares, but it was not until the seventeenth century that the mould board was introduced, which remained of wood until 1760, when supplanted by iron ones. Wooden mould boards were used generally, however, until 1830. To-day we have every form of plow suitable for every operation of the farm, made of the best chilled iron and steel, with any part replaceable at will.

Of turn plows we have three general types:

1. A flat share and upright colter, cutting a rectangular furrow, and reversing, when it is used for sodding.
2. Crested or high cut plows, with share raised on the wing side, and an under cut colter throwing a furrow whose cross section is a trapezium, and is used for winter plowing, so as to expose the furrow to the largest influence of the freezes of winter.
3. Turn plows, which throw wide furrows up against each other at regular angles and are used for tilth.

Again, we have common plows which turn the soil; digging plows, like our scooters and straight shovels; swivel plows, which throw each furrow in same direction and are popular in hillside work; double mould board plows, which throw two furrows in opposite directions at the same time; subsoil plows, which stir the subsoil without bringing it to the surface, and special plows, like the potato plow, the beet plow, etc., used for harvesting root crops.

Even the shape of the share modifies the work performed. A slightly rounded, pointed share will perform square work in open land, and a flat share with short point is used in shaving land, and a long pointed share is used for breaking hard and stony land.

Cultivators may be arranged with grubbers; broad shares like your sweeps and scrapers and scarifiers, like our harrows and narrow bull tongues. Harrows are used to pulverize clods, smooth the surface and cover light and small seeds, and are a combination of plows. The roller is used to compact the earth and pulverize clods, and is a most useful instrument upon open soils.

In conclusion, permit a résumé:

All soils are comminuted rock particles and must be broken and exposed to the disintegrating agents, to prevent incipient rock making, to furnish easy permeability to roots, and to yield soluble food for the plant.

Thus breaking is done by turn plows, double mould board plows, subsoil plows, harrows, etc. If well done, an excellent tilth is established.

Cultivation should look only to the maintenance of tilth and moisture, and should be practiced frequently. The instruments to be used depend largely upon the character of soil.—The Southern Planter.

* A synopsis of a lecture delivered by request before the North Louisiana Agricultural Association, by Dr. Wm. C. Stubbs, Director of the Louisiana Experiment Station.

KASHMIR: ITS PEOPLE AND ITS PRODUCTS.

By WALTER R. LAWRENCE, I.C.S., C.I.E.

MY paper this evening is entitled "Kashmir: its People and its Products." I shall not dwell at any length on Kashmir's chief charm—its scenery; for at the close of the paper I propose to show you photographs which will depict more vividly than words the scenes which delight all visitors. These photographs are the result of the patient and laborious work of my friend Mr. Millais. I can vouch that they are accurate and instinct with the very spirit of the valley. Mr. Millais' name will be sufficient guarantee that the photographs are artistic.

I must, however, say a few words about the scenery and the configuration of the country. The beautiful valley is cradled in the Himalayas at an average height of 6,000 feet above the sea. North, east and west, it is shut off from the outer world by range after range of mighty mountains, while on the south it is separated from the British province of the Punjab by rocky barriers 50 to 75 miles in width.

The valley, that is the cultivated part, is 84 miles in length and 20 to 25 miles in breadth, and from the south to north and northwest it is traversed by the great river which we call the Jhelum, the Kashmiris call the Veth, and the ancients called the Hydaspes. The delta of the river in Kashmir is the Wular lake, a beautiful sheet of water covering some 80 square miles. In its course through the valley the river flows gently, and Horace's words, "lambit Hydaspes," are the best description of the smooth, easy current of Kashmir's great waterway. But when the river reaches Baramula it leaves for ever the grassy banks of the valley, and hurries down its rocky, torrent course to the hot plains of the Punjab.

In the valley, wherever you look, you see mountains, ever varying in shape and color. There is the grim Haramak, which guards the entrance of the Sind Valley. It was my North Pole, to which we laid our maps when a compass was not handy. There are many legends clustering around Haramak, and the natives say that the presumptuous mountaineer who dared to scale the snow peak would meet with instant death. In the crest of the mountain there is said to be a vein of emerald which renders innocuous all snakes which lie within its ken. It is a curious fact that the poisonous snakes of Kashmir only occur in valleys which are hidden from the eye of Haramak. All around the valley are well-known peaks, all rich in legends, and above all towers the grand promontory of Nanga Parbat (26,600 feet). The sad fate of Mr. Mummery lends a painful interest to Nanga Parbat.

I suppose that all dwellers in a valley who watch great mountains, with their clouds and thunderstorms, are more prone to superstitions and legends than the people who live on the great plains of India; and I attribute much of the superstitious element in the Kashmir character to the daily contemplation of mountain scenery in its most finished form. The coloring of the mountains is exquisite. In early morning they are often a delicate, semi-transparent violet, relieved against a saffron sky, and with light vapors clinging around their crests. Then the rising sun deepens shadows, and produces sharp outlines and strong passages of purple and indigo in the deep ravines. Later on it is nearly all blue and lavender, with white snow

peaks and ridges, under a vertical sun; and as the afternoon wears on, these become richer violet and pale bronze, till the last rays of the sun have gone, leaving the mountains a ruddy crimson, with the snows showing a pale creamy green by contrast. You descend from the mountains, you leave the glaciers fringed with the useful birch tree, and descend to grassy glades surrounded by deep forests of pines and firs. Down through these forests fall streams white with foam, passing, in their course, through pools of the purest cobalt. Then you come to villages and terraced cultivation, and lastly to the level stretches of the varied colored rices. Everything in Kashmir is rich in contrasts. The East blends with the West. The delightful plane trees, the magnificent walnuts, the endless willows, the poplars and elms, the wealth of mulberries, and the countless orchards of apples, pears and apricots will remind you of a well-wooded English park. But the crops, the rice with blooms of art color, the sulphur petals of the cotton, fringed with the scarlet of the amaranth (our "love lies bleeding"), are of the East. The rounded forms of the trees, the rivers and streams with their banks of green turf and willows recall the West.

The very villages are almost English. Like our Saxon ancestors, as described by Tacitus, "suam quisque domum spatio circumdat," and instead of the ineffably dreary and unvillagelike look of the Indian hamlet, we have in Kashmir the picturesque homesteads dotted about here and there. All have their little gardens and courtyards. Near the cottage is the wooden granary—not unlike a huge sentry box. In the courtyards the women are pounding the rice and maize, and the cotton wheel is for the time laid aside. Dogs are sleeping, and little children are rolling in the sun, while their elder brothers—also children—are away looking after the wild cows and cattle. Most villages have a delightful brook on which is a quaint looking bathing house, where the villager leisurely performs his ablutions. One of the prettiest objects in the village is the graveyard, shaded by the Celtis Australis and bright with iris—purple, white and yellow—which the people plant over their departed relatives.

Time will not allow me to describe the beautiful lakes or the mountain meadows, known as Margs, where English visitors live in pine-wood chalets on the fringe of the forest. The lawns and flowers which nature gives would make most gardeners pause. Nor can I tell you of that loveliest angle in the world—the Dal lake, with its beautiful parks and gardens, reminiscences of the Moghal times. All I can say is, that Kashmir can be reached in three weeks from London; that it has a most delightful and varied climate; and that for a holiday or change there can be no more restful and healthy life than a year or six months sojourn in the valley of Kashmir. The Dolce far niente existence in the house boats on the river and lakes, or, still better, the gypsy life in the tents would give a new lease of life to many. You will meet with the kindliest welcome from the ruler of the country and his officials; and if you happen to have a medicine chest with you, you will be received with acclamation in the most secluded villages. I have often come across English ladies camping by themselves, which speaks well for the courtesy of the people and the safety of the country. Whatever your tastes are, you satisfy them in Kashmir. There is sport, excellent and varied; there is scenery, ah! such scenery, for the artist and the layman; mountains for the mountaineer; glaciers for the botanist; a vast field for the geologist; and magnificent scenes for the archæologist; and you can live well in Kashmir on £200 per annum. Go, if you can, in the early spring, in order to see that marvel of colors, the blooms of the almond groves, and the pink and white promise of the orchards. To enjoy Kashmir, as indeed to enjoy anything in the East, you must enter into the spirit of the hemisphere; you must saunter, an l ignore time. If you rush on, from one camping ground to another, you will miss many a point of natural character which might interest and amuse you. And I think the Kashmir people are worth some study.

Up to the end of the 14th century, Kashmir was the seat of a Hindoo kingdom strong enough to interfere in the politics of India. The old temples tell more vividly than words that these Hindoos were men of grand ideas Then, by preaching or persecution, the people left their glorious temples and their picturesque religion for the poor and sullen compromise of Islam. At the end of the 16th century a further change awaited the Kashmiris. The beauty or rumored wealth of the valley attracted the adventurous Moghals, and after obstinate fighting in the difficult passes, Kashmir came under a foreign yoke. These grand Moghals loved the valley; they built "sunny pleasure domes," such as Coleridge dreamed of in "Khubla Khan," and they planted the noble plane tree. They have bequeathed to posterity the love stories of Selim and Naurmahal. On the whole, the lot of Kashmir was not unhappy in the Moghal times, and the people still speak with affection and admiration of the Emperor Jehangir and his lovely consort, the "Light of the World." But to the Moghals the brutal and oppressive Pathans succeeded. Give a Pathan a chance, and he is a bully and a fiend. He had his chance in Kashmir and he ruined the country and the people. The Pathan was driven out by the Sikhs. It was a change for the better, but the Sikhs left much to be desired. Moorcroft, who traveled in Kashmir in the Sikh times, tells us that the punishment for the murder of a Kashmiri by a Sikh was a fine of two rupees. Crossing a pass, he came upon a young man whose throat had just been cut, and saw three other corpses, "some of the followers of a native official who, to the number of forty-five, had perished in crossing the path lately in rough and cold weather against which they were ill defended by clothing or shelter. Some of the people accompanying us were seized by our Sikhs as unpaid porters, and were not only driven along the road by a cord tying them together by the arms, but their legs were bound by ropes at night to prevent their escape."

In 1846—just fifty years ago—we made over Kashmir to Maharaja Gulab Singh, chief of the warlike Dogras, a Hindoo. He was a stern, strong ruler; feared and respected by the Kashmiris. His methods were Oriental and effective. Kashmir was full of bandits, and Gulab Singh made up his mind to stamp out crime. He made each punishment an object lesson. I have heard from eye witnesses many of Gulab Singh's endeavors to make punishment deterrent. A soldier had murdered a child for the sake of her jewelry—a common form of crime even now in India. Gulab Singh sentenced him to hard labor on the road. Months after, Gulab Singh happened to be walking along the road on which the criminal soldier was working. He asked him how he was progressing, and the man, encouraged by the affable manner of the Maharaja, said, "Don't you think I have been punished enough for my little offense?" "I quite forget what it was," said the Maharaja. On hearing what the offense was, the Maharaja mused, and then called to a carpenter who was working on a bridge. He then demanded a pen and ink, and removing the criminal's clothes, he carefully marked his body into four parts. "Now," said he to the carpenter, "saw him in four pieces, and send a piece to each of the districts. I will show the people that I do not consider child murder a little offense." These punishments have had their effect; crime is non-existent in Kashmir. Within the last ten years only one Kashmiri has suffered capital punishment. The people are afraid to commit crimes.

You will see that Kashmir has undergone many changes in its governors, and there is a deep-rooted disbelief in the continuity of affairs. The governors and their deputies have, unfortunately, felt no sympathy for the people, so that the Kashmiris are hopeless of benevolence or justice in their rulers. It has been the deliberate policy of the Brahman officials of Kashmir—known as the Panchits—to exaggerate the difficulties of administration in the valley. They excused their own corruption, cruelty, and ignorance by assuring their masters that the Kashmiris were lying, lazy, and dishonest. No dog has ever been given so bad a name as the Kashmiri serf, and I was solemnly assured when I began work in the valley, that fair and humane methods would lead to a revolution and to the depletion of the treasury.

Apart from the evil effect which cruel and unsympathetic governors have worked on the timid character of the Kashmiri, other causes have conspired to make him doubtful and hopeless. Kashmir is a country where nature rejoices in her strength. Earthquakes, floods, fires, cholera, and famine are familiar to every generation. Take one village as an example. In the village of Pattan there is a normal population of 165 families. In 1885, seventy persons perished in the earthquake. In 1892, fifty-five persons were carried off by cholera. This is enough to unsettle strong-minded Anglo-Saxons, and with the tyranny of man on the one hand, and the terrible vagaries of nature on the other, the Kashmiri has become incredulous of the existence of good in man or in nature. He always gives me the impression that he has just recovered from a fright, or that he is expecting some disaster. They have sad memories; their very songs are those that look back to a melancholy past and forward to a melancholy future. Hardly a day passes without mention of the great famine of 1877-79, when men turned cannibals, and three-fifths of the population is said to have perished. The Kashmiris sigh as they quote the proverb "Drag tsalih, tah dág tsalih na." The famine has gone, but its stains remain.

And though famine has gone, I hope and believe never to return, and though tyranny, torture, and the corvée have gone, their stains remain, and we must make allowances for faults in the Kashmiri character.

They are timid and somewhat effeminate. They wear a womanly dress. A kind of heavy woolen nightgown falling to the feet. Under this, if it be cold or wet, they insert a small earthen brazier of hot embers, known as the "kángar." This keeps them warm, but it has its drawbacks. They go to bed with their kángar, and set the house on fire, and it is said that the brazier is the fruitful source of cancer.

They are lazy when they have no interest in their work, but when they are working for themselves they are most energetic and efficient. Up to quite recent times no one ever knew that he was certain of reaping the fruits of his labors. Their simple proposition, "Yus karih gonglu sui karih káro," he who plows shall reap, was ignored at harvest time, and everybody took what he liked. Everything was taxed, and the farm of a tax often brought with it social distinction and sometimes wealth. It was part of my business to put down the soldiers of fortune roving, often without a commission, to collect taxes on violets, birch bark, or some medicinal herb. I explained to them that there was not room for them and for me, and that violets must bow to the land revenue. With officials plundering, and hordes of tax farmers, real and fictitious, with regiments of soldiers whose sole duty it was to assist in collection, it is no wonder that the Kashmiri took refuge in lying and subterfuge. When face to face with the Pandit officials the Kashmiri villager will urge his case with the fervor of St. Paul and the inaccuracy of Ananias; but remove the officials, and set him up before his fellow villagers, and the Kashmiri will speak the truth. It is a grave charge to bring against a nation to say that it is a nation of liars, and after six years' constant intercourse with the people of the villages, I can say that the charge is not true. All cases connected with land came under my jurisdiction, and it was my practice to hear these cases on the spot. The Kashmiri was ashamed to lie in the presence of his neighbors. If he did sometimes lie, there was a telegraphy in the eyes of the men who stood around which gave a quick clew to the truth. The parish council of white bearded elders was to me a most useful institution. I do not say that the Kashmiris are an exemplary people, but I do say that they have many excellent qualities; and I maintain that, under a just and sympathetic government, they might grow into a fine, manly nation. They are intellectual, dexterous, and witty. They can turn their hands to anything. There is cultivation in Kashmir that would astonish Europeans; there are art wares in Srinagar that have astonished the world. The meanest peasant likes to display his wit, and every day I heard some shrewd, humorous remarks.

In their domestic life they are admirable. One never hears of scandals. Like the Irish they are kind to their children and the old folk. There are many points of resemblance between Kashmir and Ireland. Both are small countries, which have suffered or derived benefit from the rule and protection of more powerful nations, yet have never welcomed any change or improvement. Both Kashmiris and Irish love a joke, are fond of harmless deceit, and are masters of a good humored blarney. Both have the same deep rooted objection to paying their rents.

The Kashmiris are a very gentle people. They quarrel but never go beyond invective or abuse. The sight of blood is dreadful to them, and in some villages if a fowl has to be killed for food the execution devolves on the village priest. But in invective they are past masters. You will hear two women quarreling from their respective boats. The men sit quietly enjoying the scene of the noise. For hours the shrill abuse continues, and when evening comes and the women are hoarse they rise and invert their rice baskets. This is the sign that the fight is over for the day, but at early morning the baskets are set up again, and the wordy war begins afresh. People talk of Billingsgate, but commend me to a Kashmiri virago. The Kashmiri is loud and voluble when he thinks that he has been injured by a man. A common expression is that he will make himself heard as far as London. Sometimes when I had the misfortune to give a decision regarding land against a man, who there and then lifted up his voice and said he would proclaim the injustice of my order as far as London, I have taken him aside to ask where London was. The inevitable answer was "London, as your honor knows well, lies beyond Sukkur Bukkur on the Indus." This was the ultima thule of Kashmiri peasants' thought. They are a people of hyperbole and symbols.

Formerly, it was no doubt necessary to attract the attention of their rulers by some striking demonstration. Men who have a grievance will fling off their clothes and smear themselves with mud. The nakedness implies destitution; the mud signifies that they are reduced to the condition of a clod. Many a time I have seen a procession: one man wears a shirt of matting, another has a straw rope round his neck, with a brick pendant; another carries a pan of hot embers on his head, while in the rear comes a woman bearing a number of broken earthen pots. This was bad, but more inconvenient was the practice of casting a plow under my horse's feet as I rode along, in order to emphasize the fact that agriculture no longer possessed charms for the proprietor of the plow.

Once, as I was hearing petitions, I noticed an elderly Hindoo standing for at least five minutes on his head. No one took any notice of him. At last, fearing the old man might injure himself, I had him placed on his feet. When questioned as to his attitude, he said that, thanks to my arrangements, his affairs were so confused that he did not know whether he was standing on his head or his heels.

A man once came to me carrying the corpse of a child, and alleged that his enemies would not allow him even burying ground. He had a land suit in his village, and he wished to strengthen his case by arousing my indignation. Once a man appeared at Nágmarg, a place some 9,000 feet high; he was stark naked, and said that his uncle had turned him empty into the world. It was bitterly cold, and night had fallen, so I gave him a suit of old clothes, and, by way of jest, said that, as he was now dressed as an Englishman, he should assert his rights. He shambled down the mountains, and next day the uncle came into my camp, charging the nephew with an aggravated assault, and offering in his shattered appearance convincing proof. It is always dangerous to jest with Kashmiris.

The ruler of Kashmir is a Hindoo. Over 93 per cent. of his subjects are Mussulmans. The officials of the country for the most part belong to the rigid Brahman caste. But the oppression in Kashmir, which up to quite recent times formed the text of newspaper articles and books of travel, was entirely official, and did not arise from religious intolerance. There has of late arisen in India a spirit of revivalism in the two great religions of Brahminism and Islam. In Kashmir, however, Mussulmans and Hindoos live together in delightful amity. One reason of this charming tolerance is the fact that beef is never heard of, and kine killing is an offense punished most severely. But the chief reason is that the people of the valley, Mussulmans in name, are at heart Hindoos. The religion of Islam is too abstract to satisfy their superstitious cravings, and they turn from the mean priest and the mean mosque to the pretty shrines of carved wood and roof bright with the iris flowers, where the saints of past time lie buried. The Kashmiris are nicknamed in the East the "Pir Parast," or saint worshipers. They believe that "the saints will aid if men will call," and regard a dead saint as more efficacious than a living priest. All that there is of adoration and reverence in the Kashmiri character expends itself on shrine worship, and the poor priest and the ruinous mosque are neglected until cholera or some great calamity comes. Then Islam raises its dead: and in cholera time, I have heard the priest addressing the silent, frightened crowd as they sat helpless in the graveyard. He used King Solomon's very words at the dedication of the temple—

> "If there be in the land famine, if there be pestilence,
> Then hear thou in heaven thy dwelling place, and forgive."

The voluble Kashmiri is silent when he knows that his troubles are not of human origin. I was in Srinagar, in 1892, when the daily death rate from cholera had risen to five hundred. I was struck by the hushed silence which had fallen on the famous City of the Sun. A native friend explained it. A Panditani had lost a son, and mourned loudly. A spirit appeared and taunted her with wailing for one son, adding that before night she should have real reason to mourn. Before night she had lost her husband and her two other sons. No one wailed after this. Kashmir is rich in superstitions, and lovers of the supernatural will find a grand field in the villages of the remoter valleys. Night after night as I sat by the camp fire I would hear the quaintest and most stirring legends. Demons on the mountain passes in the shape of fair women, dragons in the deep green lakes, which are found on the higher ranges—underground rivers and an underground world where the serpent gods hold sway, divining springs and trees of ordeal—and caverns where men controllers of the wind live their solitary responsible lives. The Brahmans astrologers of Kashmir are famous in the East, and the wild sooth-

sayers of the valley have an immense reputation. It was curious to have daily business with clever, shrewd farmers and officials, all absolutely believing in these old world superstitions. But the things dreamed of in the Kashmir philosophy date back to the times of the old saints, and the Kashmir mind, keen and intellectual in mundane affairs, is in things spiritual slumbering in the beautiful old shrines.

I must now leave the people and say something of the products of the valleys. Agriculture was my chief pre-occupation, but it would not interest you to hear about our staple crop, the rice. It will be more interesting to know that almost all the vegetable products that exist in a temperate climate can be grown in the vale of Kashmir. It is my hope and ambition that Kashmir may become the California of India. Our fruit is magnificent, and it comes to us so easily. We have everywhere an endless supply of wild stock, and from our nurseries we give out thousands and thousands of trees grafted or budded with the best English and French varieties of apples and pears. A tinning industry was introduced two years ago, and is thriving. We have large vineyards, from which excellent wine—Medoc and Barsac—is made. We have recently replanted these vineyards with American stock in order to combat the phylloxera, which has penetrated even to remote Kashmir. We have made excellent cider, and the brandy which we distill from the wild apples and pears is pure and potent, and is the one spirit drunk by the natives of the city. We have succeeded admirably with hops, and the financial results would surprise Kentish growers.

But our great hope lies in sericulture. Silk is an ancient industry in Kashmir, and it is probable that the valley was a producer of the old Bactrian silk which found its way to Damascus and other centers of manufacture. But evil days befell silk, and in 1878, disease obliterated the industry. In 1889, when I first went to Kashmir, it was decided, on the advice of Sir Edward Buck, C.S.I., to rehabilitate sericulture, and to stamp out disease by following the Pasteur system of microscopical examination. For the first two years it was difficult and disappointing. A native with a microscope is a most uncertain combination. But eventually we succeeded, and a few weeks ago the first Kashmir silk found a sale in London. As regards its quality, experts can speak. I can only say that, being an amateur, I have advised the state not to incur expense on improved reeling appliances, and my object has been to make sericulture pay its expenses, and to demonstrate that good silk could be raised in Kashmir. I can give you no good idea of the wealth of mulberry trees that are wasting and waiting for the silkworm. I can only say that European capitalists will find in Kashmir the elements which contribute to successful sericulture. The Kashmiri house is eminently adapted for the rearing of silkworms; there is abundance of skilled labor in the presence of the "Kirm kash," or worm destroyers, families with an hereditary connection with silk; and, above all, there is an endless supply of mulberry leaf.

All that is wanted to realize my dream of an Indian California is European capital and European skill and energy. Already Europeans are carrying on a profitable business as manufacturers of carpets, and their capital and supervision have proved of great assistance to the unfortunate weavers of the old shawls for which Kashmir was once famous throughout the world. The French and German war destroyed the shawl trade, and the poor weavers, too soft and too sedentary for agriculture, would have perished had it not been for the carpet trade.

Everywhere we have splendid water power, and if capital were forthcoming, cotton mills might be erected which could supply Kashmir and Central Asia with cloth. Our local cotton is excellent in quality, and the cloth of the hand looms is preferred to the piece goods from India. It wears longer, and is better value for the money. Then the valley abounds in fibers. One of these is especially worthy of European notice; we call it Yechkar. This is the Abutilon avicennæ, and its fiber has been pronounced superior to Indian jute and finer than Manila hemp.

The people of Srinagar are born artisans, and the European capitalist will find apt men, of all handicrafts, ready to hand. Just as the Kashmiris prefer the home cotton cloth, made locally, from the native cotton, so they prefer the iron of Kashmir to the imported metal. It was described to me by an expert, who held most sanguine views as to the future of Kashmir iron, as being equal to mild steel. Many hold that the valley and the mountains which surround it are rich in minerals; and the chance discovery of the rich sapphire mine in 1882 suggests that organized exploration might result in further discoveries. As I have pointed out in my book on Kashmir, it is a mistake to suppose that the natives of the valley would be eager to disclose the existence of rich lodes. They are an agricultural or pastoral people, and their experience in the past teaches them that the discovery of mineral wealth is attended with drawbacks, in the shape of forced labor and of numerous officials who must be fed. I have often discussed the question of iron mining with the villagers who live near Sof, the chief iron field, and if their views on the subject of mineral wealth represent the general ideas of the people, it is no exaggeration to say that the Kashmiris detest the very name of mining.

Time will not allow me to tell you of the floating gardens of Kashmir, like the Chinampas of old Mexico; nor can I tell you of the saffron fields, for which the valley is renowned. The author of the "Ragataraangini," the famous Sanskrit history of Kashmir, who began to write in 1148 A. D., alludes to the saffron in his introduction:

"Kashmir is a country where the sun shines mildly, being the place created by Kashaypa as if for his glory. High school houses, the saffron, iced water and grapes, which are rare even in season, are common here. Kailasa is the best place in the three worlds; Himalaya the best part of Kailasa, and Kashmir the best place in Himalaya."

I agree with the old chronicler, and I think that any of you who can find the time to visit Kashmir will also agree that it is the best place in the world.—Journal of the Society of Arts.

THE first smelting furnace fired with coke used on the continent of Europe was erected by Wilkinson in Creuzot, France, in 1782.—Stahl und Eisen.

AN EXCURSION TO PAIOLIVE WOODS AND THE GORGES OF ARDECHE (FRANCE).

THE numerus tourists who travel over France in the fine season are now acquainted with the remarkable gorges of the Tarn, as well as with the picturesque rocks of Montpellier-le-Vieux and the stalactitic grottoes of Dargilan (Aveyron). It is a trip that has become an easy one, and the hotels at which one has to stop are comfortable. Unfortunately, such is not the case with a neighboring region, which, in my opinion, is still more interesting, and which I had the good fortune to visit last summer. There is nothing easier than to reach the wonderful localities in Ardeche, but it is impossible as yet to find desirable lodgings there, the inns being passably primitive. The landscapes observed compensate, it is true, for such drawbacks, which every earnest tourist is capable of overlooking.

FIG. 1.—THE RAVINE OF GLEIZASSE—THE OBELISK AND KOLOET POINT IN PAIOLIVE WOODS (ARDECHE).

Upon leaving Lyons, the first stopping place of my excursion was the pretty station of Vals-les-Bains, which is very pleasingly situated upon the Volane River. The baths here are reckoned among the most celebrated of France, and yet they are not frequented by what is styled fashionable society. The patrons here seem to be of the simplest habits. They consist of invalids and of families whose members scarcely give a thought to sensational toilets. Pretty groves of verdure and charming sites are found everywhere at Vals; but this locality possesses in addition a very interesting commercial character, due to the extreme multiplicity of its beneficent springs.

The exportation of the mineral waters hence is quite extensive, and everywhere in the little streets of the town, or along the river, we see nothing but workmen occupied in packing bottles of the water that are to be distributed all over Europe. Not far from Vals-les-Bains are found some great natural curiosities that may be easily visited. These are the magnificent basaltic walls against which the village of Pont-de-la-Baume is constructed, and the sixteenth century ruins of the ancient fortified castle of Ventadour. Upon continuing on a little further along the Ardeche River, we reach Thueyts, one of the most picturesque of villages, which contains a large number of curious houses of the time of Francis I. Everything here is primitive. The antique streets of the village are lighted at night only when the moon is pleased to make its appearance, so the belated traveler, after nightfall, meets only with rare peasants, provided with lanterns, and quite a large number of swine everywhere endeavoring to feed upon the garbage deposited by housewives in front of their dwellings. Nothing could be prettier than the immediate environs of Thueyts, where we find fields and orchards delightfully situated upon rising terraces formed of the debris of volcanic rocks or scoria. We everywhere observe a shade thrown by mulberry trees, plum trees and grapevines, the branches of the latter forming flexible and graceful lianas in the boughs. Vegetables grow beneath the trees, and are thus protected against the burning rays of the sun. Thueyts is situated upon a high plain, skirted on one side by the torrent of Mederic. The water of the latter falls in cascades, from a total height of more than three hundred feet, into Ardeche River. The Devil's Bridge, formed of two superposed arches, extends across the principal fall. The village and its gardens are sustained by a high wall of volcanic rocks overlooking the left bank of the river.

Through a luxuriant verdure of boughs of aged chestnut trees we soon perceive, in following an abrupt footpath, immense colonnades of basaltic rocks. It is these that sustain the above mentioned wall, which is nearly one hundred and ninety feet in height. These strange rock formations are called the Colonnades of the Giants. Through a narrow fissure in the basalt it is possible to ascend from the banks of the Ardeche to the level of the plain in climbing up the basaltic debris that forms a sort of stairway constructed by nature. In the di-

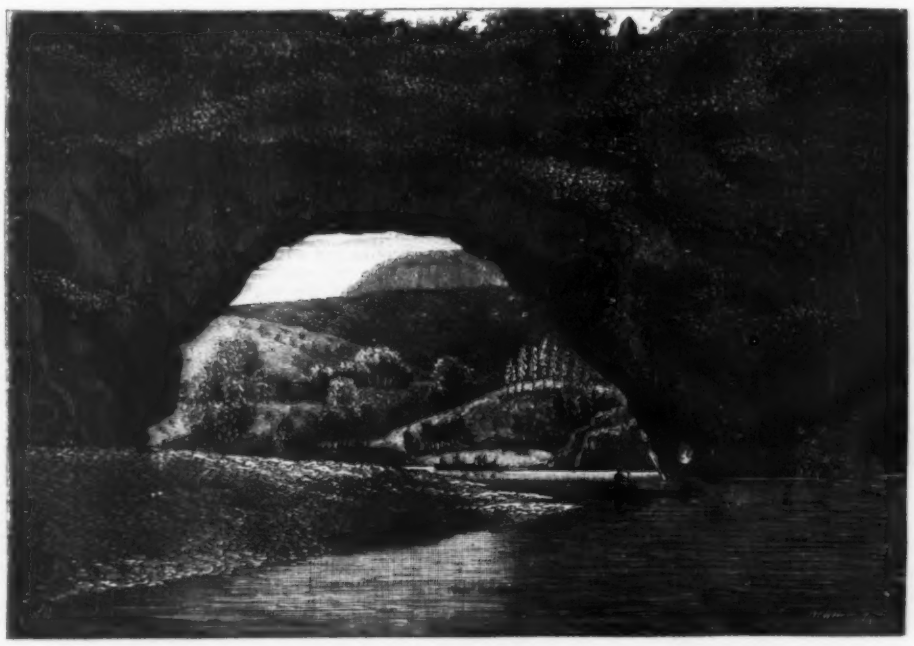


FIG. 2.—THE ARCH BRIDGE OVER THE ARDECHE RIVER—VIEW LOOKING UPSTREAM.

rection of Montpezat, near Thueyts, the ascent to the crater of an ancient volcano is easily effected. Here one enjoys an interesting view; but at present the crater is nearly concealed by a pine wood that entirely fills it. There is no longer anything to be seen but the immense debris of scoriæ that cover the entire ground. Upon leaving Thueyts, we regain the Val les-Bains railway, which takes us to Beaulieu-Berrias, near which is situated the Paiolive woods. Here are found curious rock formations called the Elephant's Head, the Rotunda, the Ruins of Sodom, etc., but the curiosities with which Paiolive is filled are so numerous that a mention of all of them would be difficult. The most picturesque part of Paiolive is that which is directed toward the north and south. It is terminated abruptly by colossal walls, at the foot of which flows the Chassezac, an affluent of the Ardeche.

At certain places it is possible for the tourist, upon entering some cavern or other formed by fissures in the rocks, to perceive the sinuosities produced by the water at the bottom of the gorges that it created centuries ago.

The most interesting of such fissures, the one called Gleizasse, is shown in Fig. 1. The panorama that is here unfolded is wonderful. At its feet is observed the emerald water of the Chassezac. In the horizon, above the mammillated rocks of the other bank, there is an extensive verdant and picturesque tract of country with the beautiful Maison-Neuve bridge in the distance, and overlooked by blue mountains. Near by, in the foreground, the immense rocks called the Obelisk and the Point of Koloet have lost their perpendicularity and threaten to fall and soon crumble away at the bottom of the abyss. At a point very near these gigantic rocks, which remain isolated, we enter a cavern more than ninety feet in length, that has been formed by an immense crevasse whose walls tend to unite with each other at their upper part.

The exploration was continued in the Paiolive woods—an extensive and fantastic labyrinth; and my guide took me to see the most picturesque parts of it. Then we redescended, in jumping from rock to rock and holding on to the bushes, to the edge of the Chassezac. We then entered the gorges, and it was possible for us at this season (August) to ford the river in order to reach the place where the boatmen are accustomed to await such peasants as have business in their fields in order to carry them to the other side. On the same evening, I returned to Beaulieu-Berrias station, where I could think about my excursion to the gorges of the Ardeche. The little town of Vallon is the starting point of this trip. Boatmen notified beforehand await you at a short distance from the town, upon the banks of the Ardeche, and take you, in the first place, to visit the remarkable stalactitic grottoes of Vallon or of Elbin, the name of their owner. The entrance is situated nearly at the top of the mountain, among calcareous rocks, and so narrow is it that it resembles, in a manner, the mouth of a fox's burrow. It has been necessary to widen it slightly in order to facilitate the access to it. Scarcely have we entered, when it becomes necessary to descend an iron ladder sixty feet in length, and then, all at once, a superb grotto of stalactites presents itself to view. Galleries and caverns succeed one another, one more beautiful than another, and thus two hours slip by. And yet such a visit seems very short in this region of subterranean wonders. I then had to regain my barge, which was a sort of flatboat, twenty-three feet in length, built of elastic planks about one and a quarter inches in thickness. Not a nail entered into its construction, the planks being connected with wooden pins, and the boat afterward being coated with a thick layer of tar.

The boatmen began to take me through the defiles of the Ardeche. They handled their frail craft very skillfully and let it glide over the rapids in avoiding the numerous rocks found therein. The gorges are interesting from the very start, made nearly at the foot of the Elbin grottoes, and the views of the two banks are everywhere equally beautiful. The first curiosities that are perceived upon contemplating the high limestone walls that encompass us before shooting the first rapid are the grottoes of the Pulpit, which are formed of openwork colonnades, partially covered with climbing plants. A little further along, upon the left bank, I saw the celebrated grotto of the Camisards, which served as a refuge to the Protestants at the time of their persecution. We soon reached one of the most curious points of the gorges—Friar's Rock and Arch Bridge.

The latter is a large arcade that has been excavated by water in the 200 foot wall called Friar's Rock. Its dimensions are extraordinary. The opening is 200 ft. in width, and the height of each arch above the mean level of the water is 42 ft. The water has further made quite deep excavations and small openings on each side. One of these may be seen in Fig. 2. I took this view of the bridge upon the bank in looking up-stream. It is upon this side that its complete development is best seen. Upon the crest of the high and narrow wall of Friar's Rock, the people of the country once made a passage, which is now almost entirely ruined. There remains, however, a sort of cornice formed in the rock and over which a person can pass with difficulty.

Many examples of rocks that have been hollowed out by sea or river water are to be seen in the world, and, among others, the arches of Etretat, those of Morgat, near Douarnenez, in Brittany; those of the Faroe Islands, and many others still, but none reaches such proportions as the Arch Bridge, which remains a marvel that is unique of its kind. In continuing the descent of Ardeche, picturesque views become innumerable, and their wild and grand character excites the enthusiasm of the traveler who is sailing along so agreeably and quickly with the current. Detours are numerous in the gorges, and produce very picturesque curves.

The curious needle of Chame, a splendid and almost isolated rock that seems to close the river, Needle Rock, a colossal detached block with a small grotto formed in its base, and the promontory upon which are still seen the ruins of the ancient Madeleine hospital for lepers, constructed by the Templars—such are some of the sights to be seen.

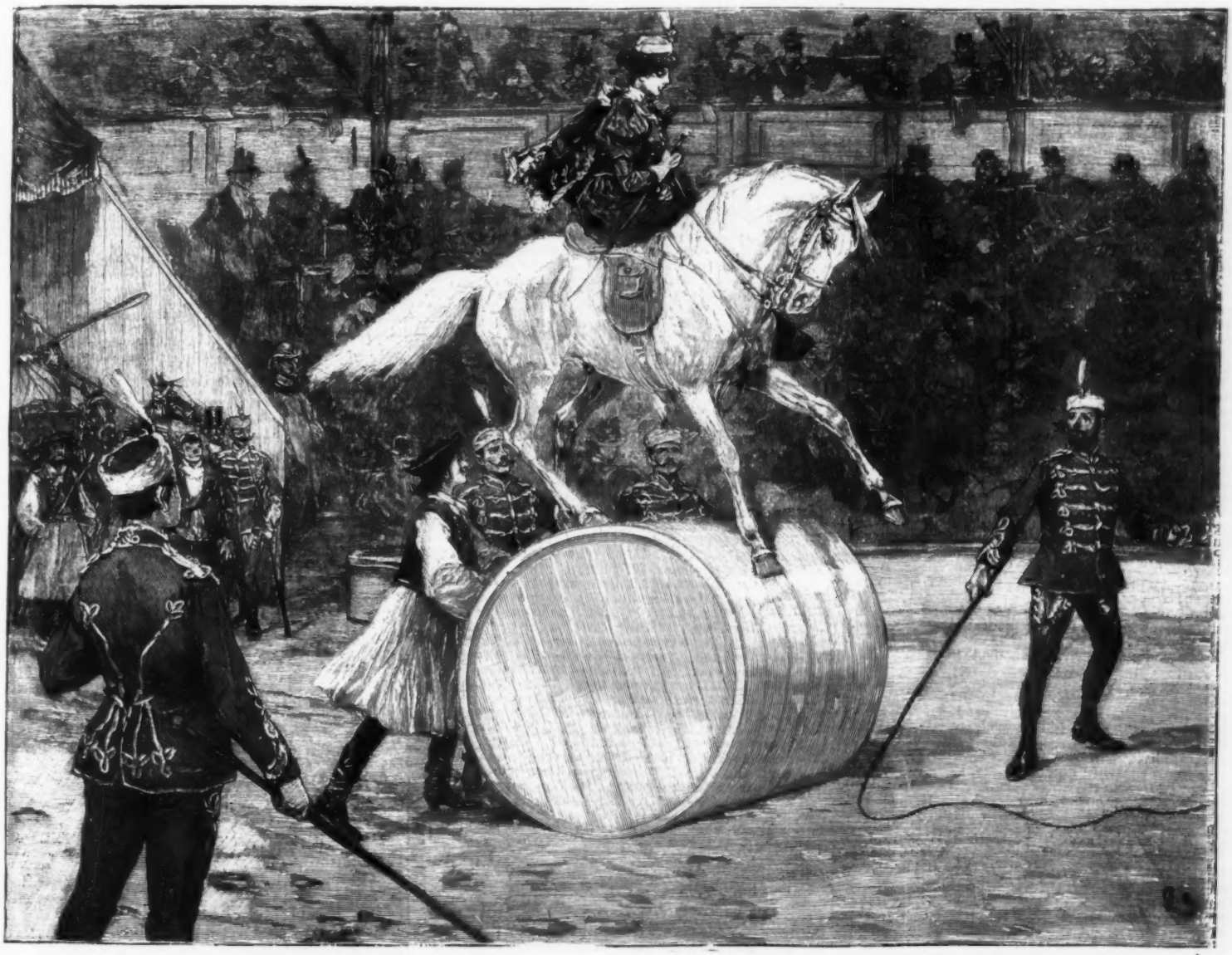
Finally, everywhere where the eyes rest there is, at every moment, nothing but aerial arcades, obelisks and pinnacles with strange shapes that form fantastic silhouettes at the top of the walls or are lost in the verdure composed of green oaks, Judas trees and junipers, that rise one above another along the banks.

These gorges begin with one wonder, the Arch Bridge, and end with another that is still more extraordinary, the grotto of St. Marcel. This large grotto is 7,400 ft. in extent, inclusive of the lateral galleries. The underground entrances show in the first place the formidable work of water, exactly as in the celebrated Mammoth Cave, of Kentucky.

They have been excavated by a subterranean river with a swift current. Then there are numerous chambers lined with stalactites and stalagmites of great beauty.

Shortly after the visit to the grotto of St. Marcel the gorges of the Ardeche began to get lower and I commenced to see the plain again. My boatmen stopped at the foot of the village of Aigueze, which is situated upon a steep cliff. The outline of its towers, of its antique castle, of its walls, and of its houses standing out from the sky, offers the most surprising aspect that could be imagined. This, indeed, is the last picturesque point of the voyage.

Almost opposite Aigueze, which belongs to the department of the Gard, the small town of St. Martin, of Ardeche, spreads out over a large plain upon the banks of the river. It only remains to reach Port-Saint-Esprit, where a grand panorama is enjoyed—that of the Ardeche emptying into the Rhone. The excursion is finished.—A. Tissandier, in La Nature.



RIDE ON A ROLLER IN BUSCH'S CIRCUS.—FROM A SKETCH DRAWN BY O. GERLACH.

A RIDE ON A MOVING ROLLER.

BUSCH'S circus is considered, even by connoisseurs, a fine school for the training of horses as well as for riding, and indeed Director Busch combines all those qualities which are necessary to make a good trainer, being a man who finds it possible to make the minds of two very different creatures, a man and a horse, act in harmony. For years he belonged to Prussia's picked cavalry, the men of which count the love of horses a high virtue. He possesses courage, strength, patience, diligence, perseverance, judges quickly and has a

feeling of justice for the animal. He quickly inspires his horses with respect and confidence—for he rarely uses the whip or force—and seldom or never with fear. Therein lies the secret of his great success.

The result of his breaking and training is shown in a pleasing manner in a feat that reminds one of the fabulous Hungarian rider and constituted a great attraction as one of the "Hungarian Pictures" at the recent Millennium Exposition. We refer to the feat illustrated in the accompanying engraving, in which the Hungarian Hengst Tiger is ridden across the track by Fraulein Motzelt on a moving roller 79 inches in diameter. By a light, elegant spring the horse reaches the top of the roller, which is provided with slats an inch apart and running parallel with the long axis of the roller, so as to give him a good hold and to facilitate the rolling movement.

Once on the roller Hengst rolls it along by stepping forward slowly, until it reaches the edge of the track, then he jumps down, rises on his hind legs, and in this position crosses the track and leaves the theater of his triumphs, his rider clinging to him as if cast in the saddle. During the ride on the moving roller the horse and rider present a fine appearance; the noble beast is so quiet that he reminds one of a monumental statue, and yet his is a most vivacious nature, almost wild. It is wonderful that by pure force of will his master has made him perform one of the most difficult tasks that could be set for any horse, even one of the quietest disposition.—Illustrirte Zeitung.

PREPARATION AND PROPERTIES OF URANIUM.

By HENRI MOISSAN, in Comptes Rendus.

IN a paper published on February 20, 1893, we have established that uranium oxide, hitherto regarded as not reducible by carbon, can yield metallic uranium in presence of this substance at the high temperature of my electric furnace. We have since demonstrated the existence of a definite crystalline compound of uranium and carbon, C_4U_2.

We shall now give a more complete study of this metal.

It is known that metallic uranium was first prepared by Peligot by reducing uranium chloride with potassium in a platinum crucible. By this procedure we obtain a gray powder, in the midst of which are found some small metallic globules.

Different chemists have slightly modified this operation, and in 1886 Zimmermann resumed the study of uranium, and obtained the metal by reducing uranium chloride with sodium. The isolated metallic globules in this preparation were few in number. Their fusion was due to the intense heat developed by the action of the alkaline metal upon the chloride.

We have repeated all these experiments. If we operate in a platinum crucible, the uranium is always soiled with this metal. In Zimmermann's preparation the uranium always contains 2 per cent. of iron and a small quantity of sodium.

Moreover, whatever is the method employed, all these uraniums in powder contain nitrogen and often oxygen. As we shall demonstrate below, metallic uranium has a strong affinity for gaseous nitrogen, hitherto unknown.

We thought that this action of the alkaline metals might be more advantageously employed by means of a double compound of sodium and uranium.

Preparation of Double Uranium and Sodium Chloride, $UCl_4.2NaCl$.—When we pass a current of vapor of uranium chloride over sodium chloride we obtain a double chloride, which on cooling congeals to a crystalline mass of an apple green color, melting at 390°, fusible about 390°, soluble in cold water, and dissociated by alcohol.

This preparation is very easily made in a tube of Bohemian glass, forming at one end uranium chloride by the action of chlorine upon uranium carbide, and causing this chloride to pass over fragments of sodium chloride placed at the other end and heated to dull redness. The solid alkaline chloride begins to be colored, seizing all the vapor of uranium chloride, and then the mass melts rapidly.

We know that uranium chloride, UCl_4, is greedy of moisture, fumes in the air, and is not easily manageable. On the contrary, the crystalline double chloride is much less hygroscopic and more stable. If fused, it yields a very stable liquid, which does not apparently give off vapors.

Reduction of this Double Chloride by Alkaline Metals.—The reduction has been effected in a very thick iron cylinder, closed with a screw stopper. It is charged with alternate layers of 300 grms. double chloride and 100 grms. sodium recently cut.

The apparatus being closed, it is placed in a very brisk wood fire, when it is heated for twenty-five minutes. The heat disengaged by the reaction is so intense as to raise the block of iron to a cherry red heat in a few instants. When cold, the cylinder is opened, and the powdery contents treated at first with alcohol at 96° to remove the excess of sodium, then rapidly washed with water which has been boiled and allowed to cool, then exhausted with alcohol and lastly with ether.

Preparation of Uranium in the Electric Furnace.—We have indicated in a former paper on uranium carbide how the industrial uranium carbide must be purified. The uranium having been brought to the state of green oxide (U_3O_8), is intimately mixed with sugar charcoal in fine powder in the following proportions:

Uranium oxide	500 grms.
Sugar charcoal	40 "

About 500 grms. of this mixture are placed in a coke crucible and submitted in the electric furnace for seven to eight minutes to a current of 800 amperes and 45 volts. We thus obtain a fused ingot of about 350 grms. The metal thus prepared, if the heating has been well conducted, contains very little carbon, and sometimes even not a trace. On the contrary, we may find in it a small quantity of oxide, which then furnishes a "burnt metal," the physical properties of which are notably modified. If the duration of the heat is too long, the metal is readily carbized, and we obtain a cast metal and then a crystallized carbide, C_2U_2. To avoid the action of nitrogen, it is better to make these experiments in a tube of coke closed at one end, and adopting the arrangement above indicated.

Refining Uranium at the Forge.—When we prepare by the above procedure an uranium containing from 0·1 to 0·5 of carbon, we may refine the exterior of the fragments by heating them for some hours in a crucible lined with green uranium oxide. To realize this experiment we must place the crucible containing the uranium oxide on the metal in the middle of another crucible filled with titaniferous carbon finely pulverized. The neglect of this precaution might produce a yellow metal coated with nitride.

Preparation of Metallic Uranium by Electrolysis.—The double uranium chloride above described is electrolyzed with the greatest ease. It yields at the negative pole a sponge of uranium containing frequently small crystals of this metal. To have regular working it is sufficient to have at the terminals a difference of potential of 8 to 10 volts. We have generally used a current of the density of 50 amperes. The bath is kept in fusion by the thermic action of the current itself.

The electrolysis is effected by means of electrodes of pure charcoal, and the chloride is placed in a cylindrical vessel of porcelain. This vessel is closed by means of a plate of porcelain, giving passage to the two electrodes and to a glass tube bent at a right angle. This tube enables us to introduce above the melted salt a current of hydrogen very dry and very free from nitrogen.

After complete cooling, the contents of the crucible are taken up with ice water, and washed rapidly with alcohol; for uranium, if finely divided, decomposes water at the ordinary temperature.

This uranium is crystalline, and certain parts near the electrode appear even in crystals measuring 1 mm. on the sides.

If we employ an iron electrode, we obtain alloys of iron and uranium of a silvery white, which may be easily filed and which have a very fine grain.

Physical Properties.—When uranium is very pure its color is absolutely white, less bluish than that of iron, though it takes a similar polish. If the metal has a yellow tint, we may always suspect the presence of nitrogen. To its specific gravity we shall return below.

Pure uranium may be easily filed; it does not scratch glass. It may be slightly carbized if heated in a crucible lined with carbon, and may be tempered.

Uranium is not magnetic when quite free from iron.

In the electric furnace uranium is much more volatile than iron.

Chemical Properties.—Uranium in fine powder, as prepared by electrolysis, takes fire in fluorine, burns brilliantly, and forms a volatile fluoride of a green color. Chlorine attacks it at the temperature of 180°, and bromine at 210°, both with incandescence. The same reaction is produced in the vapor of iodine about 260° with formation of uranium iodide. All these reactions are complete. The metal obtained by Zimmermann was not attacked by the vapor of iodine, and in a current of chlorine it underwent a limited reaction, leaving in the boat an abundant residue.

Hydrochloric acid gas attacks it with incandescence at a dull red heat, yielding a stable chloride which produces a green solution in water. Hydriodic acid attacks it near a red heat.

Uranium in fine powder burns in pure oxygen at 170° and upward, producing a very dark green oxide. Sulphur reacts about 500°, furnishing a black sulphide which is slowly attacked by hydrochloric acid, yielding hydrogen sulphide. With selenium it combines with incandescence.

As we have remarked above, uranium combines with nitrogen with the greatest ease. Fragments of the metal heated to 1,000° in a current of nitrogen became covered with a yellow layer of nitride. Uranium in powder reacts with a gaseous ammonia above dull redness, but without incandescence, producing an escape of hydrogen and leaving a black crystalline powder, which we are now examining.

Pure uranium in very fine powder decomposes water slowly at ordinary temperatures and more rapidly at 100°. This property approaches it to iron, since according to our colleagues Troost and Hautefeuille, reduced iron decomposes water at its boiling point.

Melted uranium in contact with water is covered with a layer of oxide; this action is strikingly accelerated by the presence of carbonic acid.

Analysis.—In all these researches the uranium has been separated and determined in the form of U_3O_8, and the carbon weighed as carbon dioxide.

Double uranium-sodium chloride yielded on analysis the following figures:

	1.	2.	3.	Theory.
Uranium	47·9	47·7	48·2	48·08
Sodium	—	—	10·10	9·21
Chlorine	42·3	42·4	42·01	42·68

Metallic uranium prepared by sodium gave:

Uranium	99·40	99·28

The specimen always contained traces of the alkaline metal. The metal prepared in the electric furnace contained:

	1.	2.	3.	4.
Uranium	99·121	99·106	98·021	99·520
Carbon	0·168	0·601	1·356	0·005
Slag	0·187	0·204	0·303	0·421

Uranium obtained by electrolysis:

	1.	2.
Uranium	99·27	94·48
Insoluble in nitric acid	0·52	0·27

Conclusions.—Metallic uranium may be easily obtained either by decomposing the double uranium and sodium fluoride with sodium or by the electrolysis of the same compound, or preferably by reducing uranium oxide with carbon in the electric furnace. These three methods yield good results, and for these researches we have had occasion to prepare more than 15 kilos. of metallic uranium.

Uranium may be obtained crystallized; the pure metal has properties approaching those of iron. It can be filed, carbized, tempered, and oxidized in the same manner. Its tendency to combine with oxygen is greater than that of iron; in fine powder it decomposes water slowly in the cold; its reaction with the hydracids is also more energetic than that of iron. It has a more powerful affinity for nitrogen, and without special precautions the product obtained always contains a certain quantity of this element.

This metal when quite free from iron has no action upon the magnetic needle, and in the electric furnace it is much more volatile than iron.—Comptes Rendus, cxxii, p. 1088.

SELECTED FORMULÆ.

Salt Water for Aquaria.—A satisfactory imitation of salt water for use in aquaria in which sea fish are to be preserved may be made by dissolving in 18 gallons of pure well or river water 1·25 grammes of sodium chloride, 90 grammes of magnesium sulphate, 22·5 grammes of potassium sulphate and 185 grammes of magnesium chloride. The best results will be obtained if the solution is allowed to stand in the open air in a cool place for, say, two or three weeks. A few sea algæ, such as grow on stones on the seashore, should be added. As soon as the glass walls of the container show small microscopic green spots, the water is in a condition to use. It is advisable to add some kind of sea weed, the genus Ulva being particularly useful, as they serve to keep the water in a habitable condition.—American Druggist.

Paste for Pads.—

Glue	4	pounds
Glycerine	2	"
Linseed oil	½	"
Sugar	¼	"
Aniline dye	q. s.	

The glue is softened by soaking it in a little cold water, then dissolved together with the sugar in the glycerine by aid of heat over a water bath. To this the dye is added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows:

Glue	1	pound
Glycerine	4	ounces
Glucose sirup, about	1	"
Tannin	48	grains

Give the compositions an hour or more in which to dry or set before cutting or handling the pads.—Pharmaceutical Era.

To Restore Crape.—Black crape may be freshened and made to look almost equal to new if treated in the following way: Lay over the ironing table a piece of black cambric or cloth of any kind, and pin the piece of crape smoothly through to the blanket, stretching it out to its original size. Wring another piece of black cambric out of water and lay it over the crape, patting it down with the palm of the hand. Now take hot flatirons and pass them over the wet cloth, letting them just touch the cloth, but allowing no pressure to come upon the crape. When the cloth has become dry from the heat of the iron remove it, but let the crape remain pinned down until all the moisture has evaporated and it is perfectly dry. The crape will now feel and look like new. A long veil can be renovated in this way, making sure that the part redressed comes under the edge of the wet cloth.—Lady Charlotte in London.

Koumyss.—In addition to the formula given in the National Formulary for fermented milk, the following is submitted:

Fresh milk	12	ounces
Water	4	"
Brown sugar	2½	drachms
Compressed yeast	24	grains
Milk sugar	3	drachms

Dissolve the milk sugar in the water, add to the milk, rub the yeast and brown sugar down in a mortar with a little of the mixture, then strain into the other portion. Strong bottles are very essential, champagne bottles being frequently used, and the corks should fit very tightly; in fact, it is almost necessary to use a bottling machine for the purpose, and once the cork is properly fixed it should be wired down. Many failures have resulted because the corks did not fit properly, the result being that the carbonic gas escaped as formed and left a worthless preparation. It is further necessary to keep the preparation at a moderate temperature, and to insure the article being properly finished, the bottles are to be gently shaken each day for about ten minutes to prevent the clotting of casein. It is as well to take the precaution of rolling a cloth around the bottle during the shaking process, as the amount of gas generated is great, and should the bottle be of thin glass or contain a flaw it may give way. Some few days elapse before the fermentation passes into the acid stage, and when this has taken place the preparation is much thicker. It is now in the proper condition to be used.—Pharmaceutical Era.

To Determine the Presence of Alum in Bread.—Von der Planken (Annal de Phar. Lourain) recommends that 10 to 20 grammes of bread be mixed with water to form a paste; to this is added some sodium chloride free from alkali, 10 drops of freshly prepared tincture of Campeachy wood, and 5 grammes of freshly precipitated calcium carbonate. The entire mass is triturated together, and then washed into a beaker, adding water until its volume reaches 100 c. c. On standing, the supernatant fluid will assume a grayish to deep blue color if alum be present, while if the materials are pure, a red violet color is produced.

Preventive Lotion Against Insect Bites.—

Acetic ether	5	parts
Eucalyptol	10	"
Eau de cologne	10	"
Tincture of pyrethrum roseum	60	"

One part diluted with 3 or 6 parts of water, to be used as a lotion.—Jour. des mal. cutan.

To Paste Labels on Cork.—The following formulas are from the English Mechanic:

Gum tragacanth	1	ounce
Gum Arabic	4	"

Dissolve in water, 1 pint; strain, and add thymol, 14 grains, suspended in glycerine, 4 ounces; finally add water to make 2 pints.

(2) Rye flour, 4 ounces; water, 1 pint; nitric acid, 1 drachm; carbolic acid, 10 minims; oil of cloves, 10 minims; glycerine, 1 ounce. Mix the flour and water, strain through cheese cloth, and add the nitric acid. Apply heat until suitably thickened, and add the other ingredients when cooling. This paste is suitable for almost any kind of labels, and it will adhere to almost anything.

Stomatal.—This is a dentifrice which, according to the French patent reports, is made by mixing 4 parts of terpinol, 42 of water, 45 of alcohol, 2 of soap, 5 of glycerine, and 2 of aromatics.

ENGINEERING NOTES.

Street cars are beginning to make way against omnibuses in England. Petitions for twenty-nine lines in Birmingham alone are now before Parliament, while Leeds, Manchester, Sheffield, Bradford, Halifax, and Huddersfield will apply for power to construct new tramways.

Argentina's torpedo boat destroyer Entre Rios has just reached Buenos Ayres from England, having made the run from the island of St. Vincent, a distance of 3,700 miles, without putting into port for coal. The Entre Rios crossed the Atlantic in stormy weather and proved herself a first rate sea boat.

The Melbourne Journal of Commerce states that New Zealand possesses 2,014 miles of railway open for traffic, showing an increase of 21 miles as compared with the previous year. The revenue was £1,183,041, a net expansion of £137,626. The revenue for the current year is estimated at £1,200,000, and the expenditure at £762,000. The sum of £64,743 is required for additional rolling stock and machinery.

Besides remodeling and improving old existing irrigation works in Upper Burma, the following sanctioned and revised projects will be taken up this season, says Indian Engineering: The Mandalay Irrigation Canal, which takes off from the left bank of the Madaya River, the length of which will be 39 miles, with distributaries of about 86 miles, estimated to cost 32½ lakhs of rupees. The Shwebo Canal, which will take off from the left bank of the Mu River, the length of which will be 77 miles, with distributaries of about 154 miles, estimated to cost 50 lakhs of rupees. In the Minbu district two canals are projected, which take off from both banks of the Mon River; the total length of the two canals with distributaries will be 115 miles, estimated to cost 26 lakhs of rupees.

It is quite true, says the Engineering and Mining Journal, that the kingdom of Denmark does not possess a very extended area, but the government by building railroads and buying those built by private enterprise has now succeeded in giving to its inhabitants a very cheap means of locomotion, and at the same time owns a valuable asset for a large amount of its national debt. The freight rates are already the lowest known. A bill introduced by the government proposes to abolish return tickets and only to issue direct tickets between all stations. One will be able to travel the whole length and breadth of Denmark third class for a sum not much exceeding $1.50, and the distance covered is about 300 by 200 miles. This is a reduction of 50 per cent.

In a letter to the Times, Mr. Clement E. Stretton states that for many years past it has been known to those interested in English railway history that there is no national railway museum to which old relics, drawings, and books can be presented. He says: "More than ten years ago I suggested the formation of such a museum in London. I then wrote to several of the companies, and also made an offer to present the whole of my collection to such an institution, and that offer still remains open. At the present time American engineers are in this country hunting for and purchasing important old drawings for the Field Museum, Chicago, and the French agents are obtaining similar information, no doubt for their coming exhibition in the year 1900. The result is that important links in the chain of railway history are being taken away from this country for ever, instead of being placed in a national railway museum, which certainly ought to exist in London."

The public in general appears to have the idea that using compressed air stored at high pressures on street cars is dangerous. To prove how unfounded is this view, one of the bottles or tubes that is used in street cars was tested to destruction by hydraulic pressure recently by Charles G. Eckstein & Company, of New York, at the works of Messrs. Watson & Stillman, of New York. The bottle was marked off into seven equal parts and the measurements, taken without pressure, beginning at the bottom, were as follows: 2 ft. 5 1-16 in., 2 ft. 5 1-16 in., 2 ft. 5 1-16 in., 2 ft. 5⅛ in., 2 ft. 5 3-32 in., 2 ft. 5 3-32 in., 2 ft. 5 1-32 in., outside diameter respectively. Length 5 ft. 6¼ in. over all between perpendiculars. Under a pressure of 2,500 lb. the greatest expansion was a little over 1-16 in.; at 4,000 lb., 3-32 in. When this pressure was removed the bottle returned to its original measurements. At 4,350 lb. the greatest expansion was ¼ in.; at 4,550 lb. 7-32 in., and the greatest permanent set noticed was 6-32 in. At 5,000 lb. the length of the bottle had increased nearly ⅛ in., and the expansion was 7-16 in.; at 5,280 lb. ⅝ in., at 5,730 lb. 13-16 in. The bottle burst under a pressure of 5,760 lb. The fracture was very clean, and not even a minute particle of the metal flew. The fracture extended from the neck a distance of 2 ft. ¾ in. down the side of the bottle.

The Chicago Tower Company, recently organized with a capital stock of $1,000,000, will erect on the West side a tower 1,150 ft. in height—202 ft. higher than the Eiffel Tower, in Paris. The foundation will consist of four four-cornered supports, each 50 ft. square, and meeting in an arch 200 ft. wide and high. On top of these arches will be a vast landing 250 ft. square and capable of accommodating 20,000 people. There will be six other landings, with a capacity of 20,000 more, each smaller than the one below. The topmost will be provided with a powerful search light and telescope. Sixteen elevators will carry passengers to the first landing, eight to the second, six to the third, and from there four cars will take passengers to the 1,000 ft. landing. A theater, restaurant, booths and exhibits of every description will occupy the landings. Electrical displays will be made from the top landing at night. Many other features will be added for the amusement of persons visiting the tower. The estimated cost of the structure will be $800,000. The annual income is expected to exceed $300,000 and the cost of management $50,000. Bathroom, barber and florist shops, delicacy booths and convention rooms are devised in the plans as means of revenue. On each landing will be telegraph and telephone stations. Fire works exhibitions will be given and the concert halls are expected to afford considerable income.—Chicago Journal of Commerce.

ELECTRICAL NOTES.

The Electric railway from Montreal to Lachine will be completed about the first of January. The agreement with the Lachine council calls for completion in November, but an extension of time will be allowed. The line will probably be extended to Dorval and St. Anne's in the spring.

Electricity cannot be stolen in Germany, according to a decision of the Superior Court. A man who had tapped the current of an electric company to run his own motors was acquitted on the ground that only a material movable object can be stolen and the judgment has just been affirmed on appeal.

The Manaos telegraphic cable laid in the Amazon River, to connect Para and Manaos, cost $1,000,000 and failed to work within thirty-one days after being laid. It was guaranteed for only thirty days by the contractor. No messages have been transmitted over it since last February, but it is being inspected for breaks and it is hoped that it may be in operation again before long. This cable was supposed to supplant the overland telegraph line to the center of the rubber trade, a line continually interrupted by the rapid growth of tropical vegetations and the antics of Brazilian monkeys.

Invention says that pennyworths of electric current are the latest outcome of the penny in the slot machine. The devising of a slot machine to measure out electricity on the same principle as the gas meter slot machine has long been one of the pet schemes of working electricians. A number of meters sufficient to supply 400 lights will, it is stated, be installed in a big flat building belonging to the Metropolitan Industrial Dwellings Company. On dropping a penny in the slot, and pushing a knob, the meter permits the passing of a current of electricity sufficient to run an eight candle power electric lamp for six hours. You can keep on dropping pennies in the electric meter up to 30, and 180 hours of electricity are placed at your disposal. About five minutes before the pennyworth of electricity is used up a bell rings, while by means of an indicator it can be seen how much electricity has been paid for and is still unused.

The Metropolitan District Railway has practically decided to adopt the plan for an express line underneath its present road from Hammersmith to "the city," says the Electrical Engineer. A recent report of Sir Benjamin Baker to the Shareholders' Association states that the projected line is five miles long. At the Charing Cross Station the platforms will be 63 feet below those of the present district railway, or 78 feet below the street level. The depth will be 18 feet greater at the Mansion House Station. There will be both elevators and stairways at the stations. The estimate of cost for double tunnel shafts, permanent roadway and sidings, stations, and such land and easements as may be required, with 10 per cent. added for contingencies, is $5,000,000; for electrical installation, rolling stock, repair shops, and other equipment, and for professional charges, parliamentary and other expenses, and interest during construction, $2,250,000, or in all about $7,500,000 for the five miles of completed and equipped road. The tunnel construction is practically on the Greathead plan.

The Brighton and Rottingdean Seashore Electric Railway, which was recently opened, possesses novelty. The rails are laid in front of the cliffs some hundred yards seaward. The car, standing on four long tubular legs or stilts of drawn steel, 11 in. in diameter, carries its passengers at a height of 24 ft. above the level of the rails. Each leg rests upon a small four-wheeled truck, which runs along the rails. For the single track four lines of rails, with a total effective gage of 18 ft., have been found necessary to give stability to the car in all weathers. The driving machinery consists of two 25 horse power electric motors placed immediately over two of the main legs, one on each side of the car, the shafting being carried down inside the legs, communicating by toothed gearing with the wheels. Brakes are worked by rods passing down the other two legs. The current, at 500 volts, is conveyed to the motors by means of overhead wires, the collection of the current being made by two trolleys of a special type. The car is so fitted up as to resemble slightly a small ferry steamer, there being a main deck, with a saloon in the middle part 25 ft. long and half as wide, while the saloon roof forms a hurricane deck. The line is three miles long. The car carries 150 passengers, and moves easily through the water at a rate of five to eight miles an hour. Unfortunately, this unique road was destroyed by the severe gale of December 5. It is described in detail in the SCIENTIFIC AMERICAN of current issue.

The Engineering News says: "The Pacific cable bill advocated by the Pacific Cable Company is to be pushed in the next Congress. This bill would authorize the Postmaster-General to contract to pay $100,000 per year for twenty years, for the construction and operation of an electric submarine cable connecting San Francisco and Honolulu, and such places on the coast of Japan and China as the company may select, with the approval of this government. The company is to deposit $100,000 in United States bonds, to be forfeited in case of non-fulfillment of contract. This contract would require the company to complete the line to Honolulu before January 1, 1898, so that it be capable of transmitting not less than fifteen words per minute; within one year thereafter the line to China and Japan must be built. The company may establish landing stations on the Midway Islands, between Hawaii and Japan, and belonging to the United States. United States government messages are to be transmitted free forever and to have preference, and the rate for ordinary messages between the United States and Japan and China shall not exceed $1.25 per word, and 35 cents per word to Honolulu. Press rates shall not exceed one-fourth of the cost of private messages. The house committee has reported favorably upon this bill. The length of the cable route would be 2,097 miles to Honolulu and 6,500 miles to Japan, and with 16 per cent. of slack the cable itself would be about about 7,500 nautical miles long. The cost of the cable and the necessary repair ship is estimated at $7,500,000. This would be the longest cable in the world, and deepest soundings show 3,185 fathoms. The Pacific Cable Company is a New York State corporation, with $10,000,000 capital."

MISCELLANEOUS NOTES.

Petroleum has been discovered in northern Russia. This is very important in view of the intention of the Russian government to establish a naval station on the northern coast, as hitherto the fuel (coal) had to be supplied from England.—Uhland's Wochenschrift.

Pipes made by winding thick paper or cellulose round a solid core were recently described in Dingler's Polytechnisches Journal. Between each turn a layer of molten asphalt is laid on, and the pipe is thus made impervious to air and water. The pipes are joined by means of paper sockets and asphalt. They are said to be light, and not liable to fracture.

According to Mr. Fairfax, says the Engineer, the percentage of patents (English) kept in force by the payment of renewal fees is practically the same of late years as it was in 1884. The proportions are about 30 out of every 100 patents sealed are kept in force by fees for the fifth year; 17 per cent. for the seventh year; and over 10 per cent. for the tenth year; which, considering the large increase in the number of patents during the period, indicates that the relative value of patents has been fully maintained.

Writing on the lower part of sheets of paper formed into blocks is usually some trouble, because the hand rests on a lower level than the paper. An English firm are making what they call the save-time graduated block, in which each successive lower sheet of paper is put and fastened by one side a little to the rear of the one above it. The block is thus slanting at the bottom end, and the hand rests comfortably on it, whether the block be thick or thin. The method of building up requires a long, stiff back, which provides a good hand rest. It is useful for sketching as well as writing upon, and is not expensive.

A proposal has been submitted to the authorities charged with the duty of lighting the streets of London, England, which, if adopted and found to act satisfactorily, will work a very considerable change in the sewerage systems of that and other cities. It is proposed to make use of the up draught occasioned by the burning of gas in street lamps, in order to maintain a current of fresh air through the sewer pipes. A ventilating tube is to be led from below so as to open just under each lamp flame. This arrangement, it is said, will cause an outflow from the sewer of air, which, instead of vitiating the atmosphere of the streets, will be burnt in the flame, even rendering it appreciably brighter.

A remarkable ride was recently performed by a German officer, Lieut. Hausman, of the Thirteenth Hussars, says the Army and Navy Journal. At the close of the maneuvers in Lorraine he received orders to ride to Monza to present the congratulations of the regiment to the King of Italy on the engagement of the Prince of Naples. He left Falkenburg September 12 and proceeded, via Zabern, Straussburg, Bâle, Lucerne, Andermatt and the Gotthardt to Monza, where he arrived September 19, having taken seven days and two hours to cover the distance, 730 kilometers (nearly 454 miles). Horse and rider arrived in excellent condition. Lieut. Hausman was warmly welcomed by King Humbert, who gave a dinner in his honor and gave him the rank of cavaliere.

A maritime signal station is to be established by the government off Nantucket Shoal, forty miles out in the Atlantic Ocean, in the lane of travel taken by vessels bound from Europe for New York. With its establishment the station at Fire Island will probably cease to be important as the first point on the American coast sighted by shipping bound to New York from the east, from which the agents in New York first hear from their vessels. The station has long been considered practicable, but the cost of a cable and doubt as to the part the government should play in the enterprise have prevented decisive action heretofore. Orders have been issued by the Treasury Department now directing the transfer of the Nantucket South Shoal ship to a point ten miles further out, where the waves run smoother and the bottom affords better holding ground.

The French consul at Rutschuck says that the first cocoons of the 1896 yield have recently made their appearance on the market, the greater part white, but a considerable quantity also of yellow cocoons. The yield was about 42 kilogrammes of cocoons per ounce of seed. The yield is said to be a fair average one; that is to say, an exportation about equal to that of last year is anticipated. The total production of cocoons in Bulgaria was 3,600,000 kilogrammes in 1894 and 4,000,000 in 1895. The exports amounted to 91,992 kilogrammes in the former year and 105,568 kilogrammes in the latter. Of the amount exported in 1895, 42,000 kilogrammes were consigned directly to France, 47,000 kilogrammes to Turkey, 11,000 kilogrammes to Austria, and the remainder to Italy. It should be observed that a part of the consignments to Turkey were intended to be finally shipped to France and Italy.

Vaults, pipes, etc., with an embedded layer of wire, either applied as single wires (Monier) or as a gauze, no longer being a novelty, we now hear once more of cement and concretes containing a strong vegetable fiber, says the Trades Journals Review. Ch. Voltz, of Straussburg, uses alfa fiber for this purpose. This is, so far as we know, the fiber of Macrochloa tenacissima, from which the Algerians make their paper; the article in "Glazer's Annalen," from which we quote, simply mentions the name. The fiber is placed in a mixture of fine slag or coke with plaster and lime; a layer of this material is spread, the fiber, soaked in this mixture in some unexplained manner, applied, and another layer spread. The whole ceiling, vault or wall may be made in this way, or the material may be worked into slabs, care being taken to let the fibers of two adjoining slabs unite. The ceilings may also be freely suspended. For this purpose, hooks are fixed to the beams, iron rods placed in the hooks, and the ceiling is then made with the aid of laths, etc. Load and fire tests conducted at Charlottenburg and at the imperial wharfs in Kiel, are said to have given great satisfaction. The slabs facilitate the lodging of insulators, and are convenient for complicated structures and for keeping noises out.

THE FIREPROOFING TESTS OF FULL SIZE COLUMNS AND GIRDERS.

THE disastrous fire which occurred in November, 1895, at the corner of Bleecker Street and Broadway, New York, produced a decided sensation among the builders and occupants of so-called fireproof buildings. This was due to the easy destruction of the upper floors of the Manhattan Savings Institution, a building which was popularly supposed to be constructed according to advanced ideas on the subject of fireproofing. As we pointed out at the time, there were two facts which called for special attention in this fire, the first being the ease with which the heat from a burning building, across the street ignited the interior of the Manhattan building; and the second, the ease with which the fire, when once it had taken hold of the contents, passed from floor to floor. It is certain that this disaster shook the faith of the public in the whole system of fireproofing as such; although, as a matter of fact, the failure was due to the incompleteness of the protection and merely proved that fire protection, when half carried out, is sometimes worse than none at all.

Another effect of the fire was to emphasize the fact that our knowledge of the actual behavior of columns and girders under the action of a fire is very meager, and there is no doubt but that it helped materially to hasten the carrying out of a system of tests upon full sized specimens. We have before us the report of the progress of the recently organized committee on fireproofing tests, and also a paper contributed to the November number of the Journal of the Franklin Institute, by S. Albert Reed, Ph. D., to the latter of which we are indebted for our illustrations.

In carrying out this work, the committee felt satisfied that the subject demanded a more thorough and systematic investigation than it had as yet received, although it realized that good work had been done by various investigators, notably in the case of what are known as the Hamburg tests.

It was determined to carry out the work on steel or iron columns, girders and beams, under the actual conditions which would obtain in a fire. It was decided to use gas for fuel, and make the tests at three typical temperatures, which should correspond as nearly as possible to those which a building would be called upon to sustain in a conflagration. The temperatures decided on were 2,500° F. for six hours, 1,200° F. for one hour, and 700° F. for one-half hour. Mr. Reed states that the committee determined to aim primarily at obtaining data for standard specifications, and, accordingly, it was decided not to finance the undertaking by certificate fees from material men. The funds were obtained by voluntary subscriptions from those interested with the users and not with the producers of fireproof buildings.

The tests will probably extend over several years, and cost not less than $10,000, and from the data ultimately obtained the committee hope to be able to state the requirements for a standard building, for the particular set of conditions internal and external which the building is to meet. It is not intended to advocate a prohibition of fireproof buildings short of the standard, but to establish a standard as a datum level from which allowable variations may be determined.

As showing the character of the parties who are bearing the expense of these tests, we notice that the subscription list includes such names as the Boston Board of Fire Underwriters, McKim, Mead & White, George B. Post, and the Tariff Association, of New York. Bulletin No. 2, being the report of the committee to the Tariff Association, of New York, the Architectural League, of New York, and the American Society of Mechanical Engineers, gives the following programme of test, which it proposes to make:

First, tests on steel and on cast iron columns, without any fire protection whatever. These tests then to be taken as a basis of comparison with those that were to follow.

Second, tests with similar steel and cast iron columns, protected with different materials and in different manners.

Third, tests on unprotected beams and girders.

Fourth, tests on protected beams and girders.

Each series will be divided for test both with and without water.

The present report gives the results of the first series of tests above mentioned. The apparatus as first designed for this purpose is shown in full detail in Plate IV. As afterward built the gas producer is 9 ft. in diameter by 12 ft. high. Gas is generated by means of steam from a boiler and carried into the furnaces through the pipes, shown in the diagram. The furnace to the right, which is 12 ft. wide by 27 ft. long, will be used for testing beams and floors. The taller structure to the left was used for the recent column tests. It is 14 ft. square, with an arched roof made of fire brick, which is independent of the side walls, being supported by outside corner posts. The walls are of common brick. Openings are left in the floor for the branch gas pipes, and air spaces to support combustion. The column to be tested is placed in compression by means of a hydraulic ram, which rests on 24 in. I beams. The top of the column bears against a couple of similar I beams, which extend across the roof of the furnace and are tied down to the lower I beams by means of 15 in. channels. The hydraulic ram is 12 in. in diameter, and the water pressure 2,500 lb. to the sq. in. The temperature is measured by means of a Uehling & Steinbart pyrometer.

The results of the tests on the columns are shown in Plate III. Test No. 1, the first to the left, shows the failure under a load of 48 tons at a temperature of 1,200° F. The column, which was a Carnegie steel zee bar, 12 in. square, bent, as shown, in 1 hour and 25 min. The calculated breaking load was 342 tons. Test No. 2 was made on a Carnegie steel plate and channel column, 12 in. square, calculated breaking load 303 tons. It was tested at the working load of 84·8 tons, and bent as shown in 23 min., at a temperature of 1,125° F. Test No. 3 was made on a cast iron column from Cornell Iron Works, 8 in. in diameter, 13 ft. long, shell 1 in. thick. The safe load was 90·2 tons. It bent under a load of 84·8 tons, at a temperature of 1,100° F., in 1 hour and 10 min. The increase in fire was slow. Test No. 4 was made on a similar column to the last. It bent at 1,550° F. under a load of 84·8 tons in 35 min. There was a rapid increase of the fire. Eight minutes after the column began to bend it broke in the middle. Test No. 5 was made on a cast iron column as above, under a load of 84·8 tons.

Heated to 525° F. and water thrown on; no injury.

Heated again to 775° F. and water thrown on; no injury.

PLATE I.—BUILDING AT BLEECKER STREET AND BROADWAY, NEW YORK, SET ON FIRE BY HEAT RADIATED FROM BURNING BUILDING ACROSS THE STREET.

PLATE II.—EFFECT OF FIRE UPON UNPROTECTED FLOOR GIRDERS AND BEAMS OF A BUILDING AT BLEECKER STREET AND BROADWAY, NEW YORK.

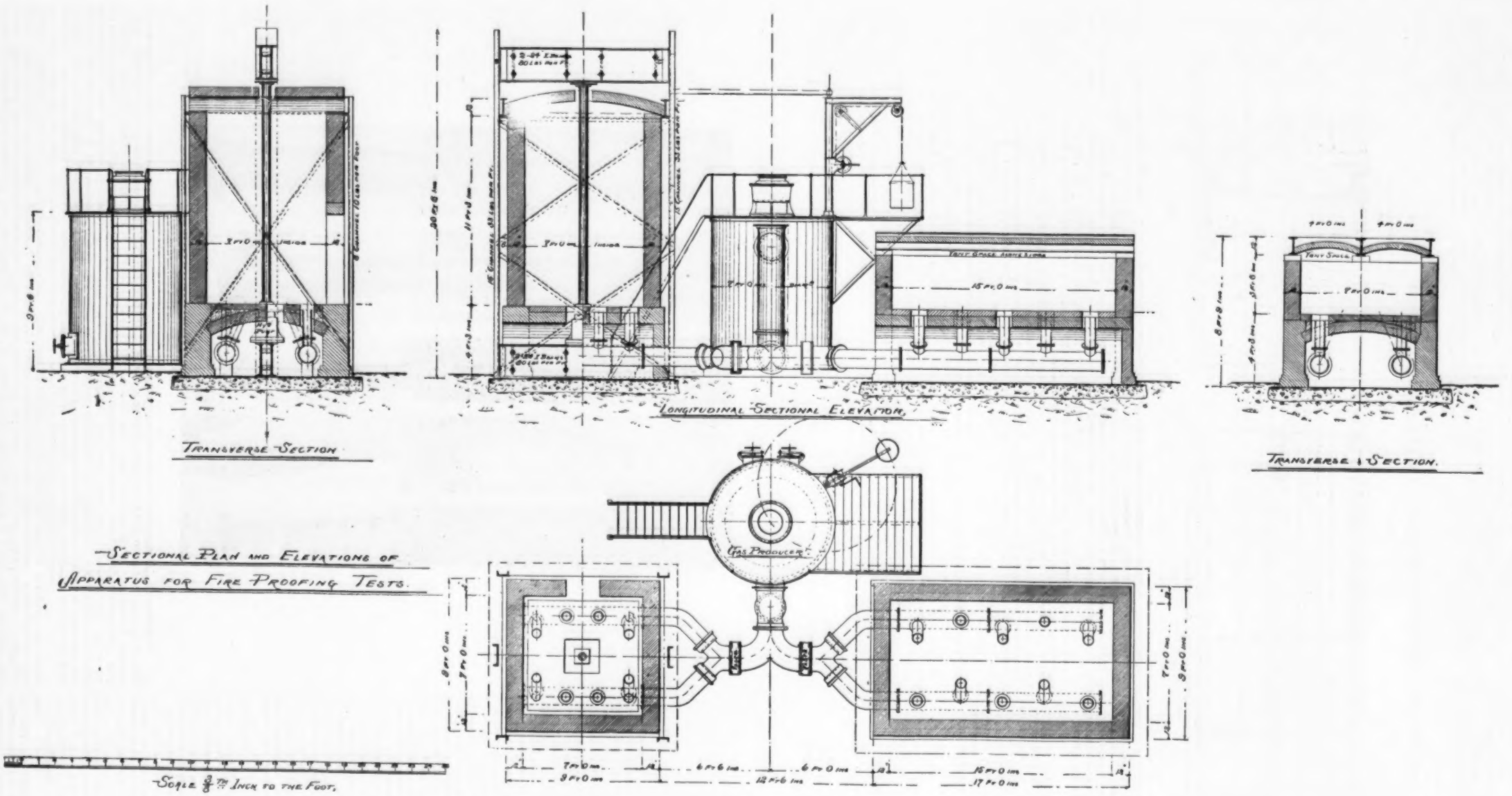


PLATE IV.—DIAGRAM OF PLANT FOR FIREPROOFING TESTS.

Heated again to 1,050° F., showing red heat, and then water thrown on; no injury.

Heated again to 1,300° F., showing red heat, and column beginning to bend, water again thrown on; no fracture of any kind resulted.

The tests of unprotected columns and girders are being undertaken in order to determine "what the task of the fireproof armor of the steel skeleton of a fireproof building is to be."

Plates I. and II. show this effect in an actual conflagration. The twisted steelwork seen in the foreground is what remains of the steel box girders and I beams of the floor above that on which the fire took place.

As Mr. Reed, who is a member of the committee, points out, the Manhattan building caught fire from the intense heat radiated from the burning buildings 60 ft. away across the street. It is not necessary for burning fragments to alight upon a structure to set it on fire. He gives a personal experience in which at a New York conflagration the radiated heat from a burning lard refinery ignited a board fence some 200 ft. distant. The window casings and sashes and the contents of the upper floors of the Manhattan Savings Institution were ignited in the same way, and the faulty nature of the fire protection brought about the collapse of the upper floors. The whole weight of these floors was carried upon 30 in. box girders (see sketch), 40 ft. long and running the width of the building. The outer end bore upon heavy and substantial brick piers and the inner end upon cast iron columns, which were built into the north wall. These girders were spaced about 24 ft. apart and carried 15 in. I beams, spaced 4 ft. center to center. Resting upon the bottom flanges of the I beams were 2 in. T irons, and the flanges of these last served to carry the single layer of fireproof blocks or slabs, which were about 3 in. thick. Two thicknesses of dressed flooring were laid directly upon the top flanges of the I beams.

The fireproof blocks were approximately flush with the base of the I beams; but they did not, as they should, project under and cover them. The lower flange of these beams had no further protection than that afforded by the ceiling piaster. The fault of this construction consisted in the fact that the whole of the lower half of the main girders had no protection against the heat of a fire. When the fierce flames struck the lower flange of these girders they stretched, and the whole girder with its load of I beams sagged down, pulling the brick pier with it. It was a natural and inevitable result and would happen in scores of buildings in which the main girders in like manner project below the ceiling line, and are without any fireproof covering.

Another serious fault and fatal economy was seen in the cheap nature of the brick protection. Instead of the solid brick arch, springing from the flanges of the

I beams, and covered to the level of the flooring with sand or ashes, there was a single layer of thin slabs of brick, with an open air space of no less than 12 in. between them and the wood flooring above. This wide space gave all the air supply necessary to turn the wooden flooring into a sea of fire at short notice. Had the lower half of the main girders and the bottom of the joists been adequately protected, and had the space between flooring and fire brick been filled in with non-conducting material, in other words, had the work of fireproofing been thoroughly carried out, the Manhattan building, in all probability, would have survived the fire practically intact.

The present series of tests will provide very complete information upon a subject the laws of which can only

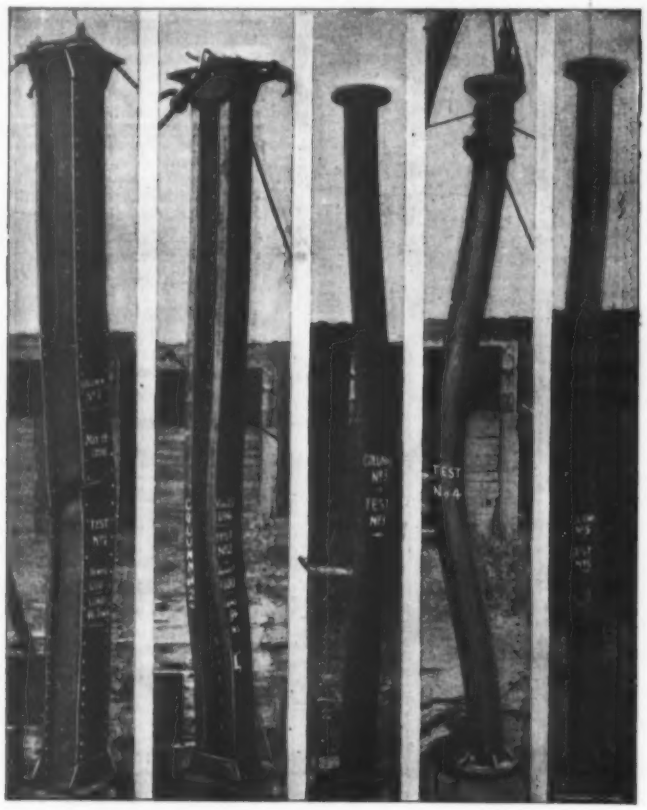


PLATE III.—VIEWS OF COLUMNS SHOWING FAILURE UNDER FIRE TEST.

be gathered in an indefinite way from such a fire as that above mentioned.

The fact that the work is being done by the voluntary subscriptions of parties who are interested in getting at the exact truth, and by a committee of such high standing, is a guarantee that the results will be thoroughly reliable, and qualified to form the basis for standard specifications.

TO EXPERIMENT WITH DIFFERENT ALLOYS FOR COINAGE.

A SERIES of interesting experiments in coinage is being conducted at the mint in this city, says the Philadelphia Record. Metals and alloys heretofore untried for the purpose will be tested and stamped into token coins. Their availability as substitutes for the alloys of which the minor coins—nickels and cents—are now made will be ascertained and samples submitted to Congress.

Of all the countless possible alloys to be obtained from copper, tin, nickel and aluminum in different combinations, perhaps fifteen or twenty may be found fairly satisfactory. It is possible that one or two of these may advantageously be brought into use for general coinage. No fault has been found with the present one cent and five cent pieces. The experiments are merely ordered to keep in touch with the times and to gain a knowledge of resources. The Philadelphia mint, while having no experimental department, is well equipped to make the tests.

Aluminum, which has never yet found a place in the currency of any nation, is to be worked up into trial coins. It is also to be given a chance in the new alloys. Aluminum is a metal of which but little has been known until recently, and it has been found useful in so many ways that a sort of popular idea prevails that it would be good for coins. Chief among its advantages would be its very light weight. Cents made of it could readily be distinguished from coins of the same size by this remarkable lightness alone.

Dr. D. K. Tuttle, the chief refiner of the mint, who knows all about the properties of metals, is somewhat skeptical, however, as to whether aluminum will come out of the proposed test with flying colors. It is extremely difficult to anneal, and when heated will suddenly run like butter instead of becoming plastic. There would be trouble in rolling it into the long strips from which disks are cut preparatory to stamping. Of course it can be worked, but not with sufficient ease and rapidity to make it practicable for coining on a large scale.

Pure nickel has recently been coined in Switzerland, but it has been found just as difficult to handle as aluminum, though for a different reason. Such great heat is necessary to bring it into condition for coining that the operation is slow and expensive. While pure nickel coins might be satisfactorily made in the mints of Switzerland, it does not follow that the same would be true at the Philadelphia mint, which is called upon to turn out fifty times as many five cent pieces as the mints of that country, and could not spare the time to work over them.

The five cent coin now in use contains only 25 per cent. of nickel, the remaining 75 per cent. being of copper. Nickel, more than any other metal, has the property of giving its color to an alloy. Even an alloy of 90 per cent. of copper and 10 per cent. of nickel will be nearly white. The advantage of using a greater proportion of nickel in the five cent piece is therefore not apparent, especially as more than 25 per cent. of it makes the alloy refractory.

The experiments at the mint will include different combinations of nickel, copper and zinc, forming the alloys known under the head of German silver; copper and tin, which produce bronze; aluminum and copper, which make aluminum bronze. German silver has been used for coins by one of the small South American states, and proved fairly adapted for the purpose. Bronze is commonly used for coins of small value. It is doubtful if aluminum bronze in any form will be found acceptable, as it is hard to work and has a yellow, brassy appearance, resembling gold, which is to be avoided in all coins of small denomination.

THE TIN PLATE INDUSTRY.

SPECIAL Treasury Agent Ayer has submitted to the department his report covering the domestic output of tin and terne plates for the last fiscal year. The report says:

"During the fiscal year ended June 30, 1896, the production in the United States of commercial tin and terne plates was 307,228,621 pounds, against 193,801,073 pounds produced during the previous fiscal year, showing thereby an increased production of more than fifty-eight per cent. Of the production for the year, 303,002,098 pounds, or more than 98½ per cent., were made from sheets rolled in the United States, against about 83 per cent. made from such sheets during the fiscal year ended June 30, 1895."

The figures show that more than 86 per cent. of the production belonged to the class of plates weighing lighter than 63 pounds per 100 square feet, the proportion being about the same as that for the previous fiscal year. Of the entire production, 69 per cent. consisted of tin plates, against 62 per cent. for the preceding year.

The report embraces the production of fifty-three firms, the output of two firms which were producing but made no report not having been considered. The report for the fiscal year ended June 30, 1895, embraced the production of fifty-five firms.

The quantity of American sheet iron and steel used was 4,300,770 pounds in excess of that for the year immediately preceding and 3,842,822 pounds in excess of the average for the four previous years.

The production of black plates in the United States during the fiscal year was 334,014,798 pounds, against 185,571,479 pounds in 1895, showing an increased production of about 80 per cent. The proportion of such plates lighter than 63 pounds per 100 square feet is 77 per cent., as compared with 80 per cent. during the preceding year. Thirty-six rolling mills were producing black plates during the fiscal year ended June 30, 1896, against twenty-eight that were producing during the fiscal year ended June 30, 1895.

Of the fifty-three firms reported as producing commercial tin and terne plates during the last fiscal year, fifty used wholly American plates, with an output of 291,725,467 pounds, and three used both American and foreign plates, with an aggregate output of 15,503,154 pounds, of which 11,276,631 pounds, or about 73 per cent., were made from American black plates. No firm used wholly foreign plates.

Of the fifty-five firms reported as producing commercial tin and terne plates during the last fiscal year, thirty-seven used wholly American plates, with an output of 131,429,609 pounds; seventeen used both American and foreign plates, with an aggregate output of 62,311,308 pounds, of which 29,047,325 pounds, or about 46½ per cent., were made from American black plates; one firm used foreign plates only, with an output of 60,156 pounds.

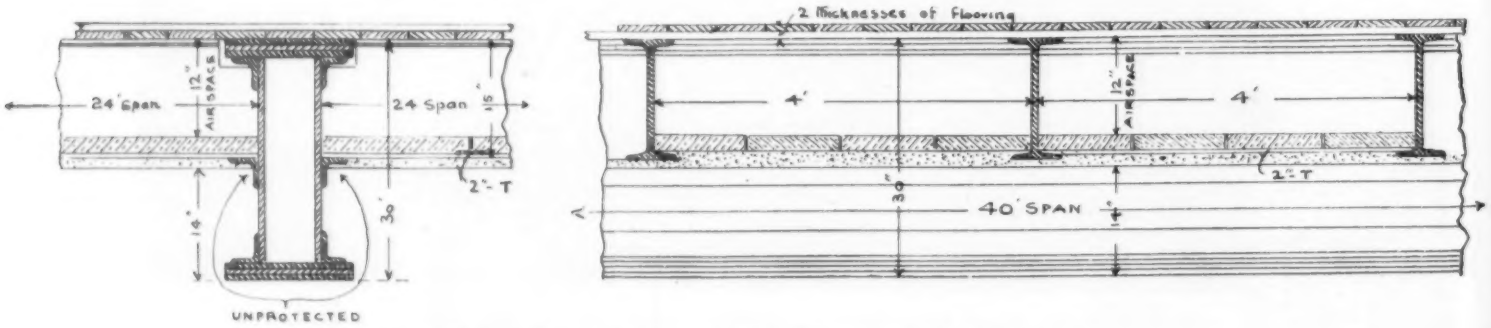
As before shown, the proportion of American rolled sheets used during the fiscal year ended June 30, 1896, compared with the entire production of commercial tin and terne plates, was 98½ per cent., as against about 83 per cent. used during the previous fiscal year.

The following is a comparison of production and net imports:

	Pounds.
Total imports for fiscal year ended June 30, 1896	385,070,372
Total exports, same period	137,659,779
Net imports	247,410,593
Total domestic production	307,238,621
Approximate consumption in United States	554,639,214
Average annual capacity of mills completed June 30, 1896 (180)	560,000,000
Same of mills completed and in process of construction June 30, 1896 (188)	585,000,000

For the 375 vacancies in the corps of Paris street sweepers there are 21,562 candidates, 6,947 persons are waiting their turn for the 115 vacancies in the kindergarten schools, and 1,955 qualified applicants have applied for 72 places in the primary schools. Eight clerkships in the municipal pawnshops brought out 2,003 male applicants, while there were 5,842 applications for 18 places as office servants at the Hotel de Ville.

New York City has made some real estate ventures that have netted better than their projectors foresaw. The total amount the city has paid for land for park purposes at various times is distributed as follows: Union Square, $116,051, in 1833; Madison Square, $65,952, in 1847; Tompkins Square, $93,358, in 1834; Washington Square, $77,970, in 1827; and Manhattan Square, $54,657, in 1839. Now these same parks are assessed at over $16,000,000, and are easily worth all of $20,000,000. London has 271 parks, containing 17,876 acres of ground. New York's Central Park contains 862 acres. The largest European park is in Denmark, which contains 4,200 acres.



THE MANHATTAN SAVINGS INSTITUTION—GIRDERS AND BEAMS.

SUBMARINE TELEGRAPHY.

A FRENCH company has obtained the concession to lay a transatlantic cable, which, starting from Brest, will end directly at New York. This perhaps will be the first step toward the carrying out of a project that will consist in organizing a system of submarine cables that shall be exclusively French, and shall permit us to communicate directly with our colonies. For the moment, we are wholly dependent upon foreigners, and especially upon the English, who own a large part of the submarine telegraphic system.

Starting from Algeria and Tunis, with which we are connected by six cables that are exclusively French, we pass over foreign cables for all our other colonies, and, during the campaign in Madagascar especially, all our dispatches passed through English hands before reaching our own. The carrying out of the project in question will require much time, labor and money, since, as regards the laying and maintenance of cables, we are not equipped therefor like England, which has made a sort of specialty of this kind of enterprises, and which is the possessor of a very complete plant and a large personnel.

The new cable will be the third one to connect France and America directly. Of the two that already exist, and that start from Brest and end at Newfoundland, only one belongs to a French company.

If we reflect upon the numerous dangers to which submarine cables are exposed, and upon the extensive traffic going on between the two countries, we shall understand why an endeavor is made to diminish as much as possible the chances of interruption in the telegraphic service. The new line will have the advantage over the others of permitting cablegrams to be sent directly from one continent to the other without passing through an intermediate station. This is not the case at present, since the dispatches are first received at Newfoundland and then transmitted by cable anew either to Boston or Duxbury. There is, therefore, some delay and danger of error, since the oftener a telegram is received and transmitted through intermediate stations, the greater is the risk of its being changed in tenor upon reaching its destination.

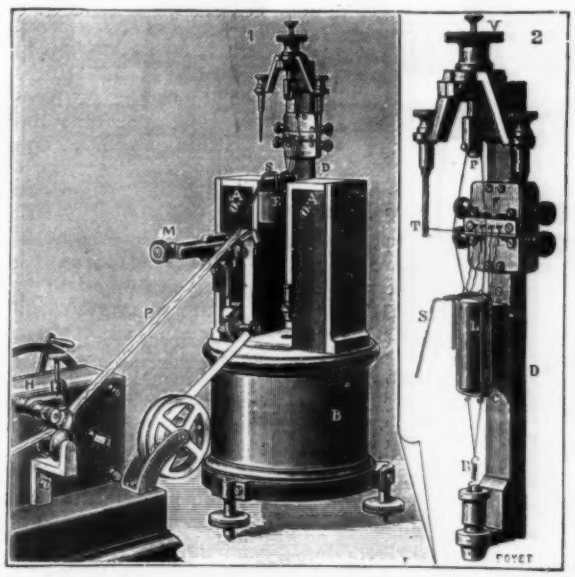
In submarine telegraphy, the chances of error are farther increased by reason of the difficulty of reading presented by the conventional signals that compose the alphabet. The apparatus employed upon the transatlantic lines are, in fact, entirely different from those used upon terrestrial ones, since in the latter we have at our disposal relatively powerful currents which are capable, to a certainty, of actuating the electromagnets through which mechanical combinations permit of printing upon a tape certain conventional signs, as in the Morse alphabet, or common typographical characters, as in the Hughes and Baudot alphabets. But, in transatlantic communications, as a consequence of the method of constructing the cables, we find ourselves face to face with phenomena of induction and condensation that permit of receiving currents of feeble intensity only. So, in order to utilize these, recourse is had to special apparatus. The simplest of these is nothing more than a very sensitive mirror galvanometer. In a dark room, a lamp sends a luminous ray to the mirror, and this ray is reflected upon a screen, where it forms a spot. The currents sent into the cable may be either positive or negative, this being determined by a manipulator arranged for the purpose. These currents consequently deflect the luminous spot upon the screen to the right or left of the observer. Now, it is agreed that the deflections to the left shall represent the dots and those to the right the dashes of the Morse alphabet. It requires long practice to be able to read such signals, and it is not till the end of several years that it is possible to succeed in doing it to a certainty.

So, although this apparatus is valuable, since the entire absence of mechanism is a guarantee of its proper operation, the idea long ago occurred to replace it, or at least to improve it. It was Lord Kelvin, better known as Sir William Thomson, who devised the first "siphon recorder"—an apparatus for registering signals. The model that he invented has undergone many modifications, and many types of this kind of apparatus are now in existence. The one represented in the accompanying figure is, we believe, not much employed, but it is simple in construction, and will allow the principle of the system to be readily understood. In these apparatus the magnet is stationary and the fine wire bobbin is movable. At A (No. 1) may be seen the polar extremities of the iron horseshoe magnet formed of united plates. The whole is provided with a metallic frame, and the base, B, conceals the rounded portion of the magnet. Behind the arms of the latter is placed a support, D, that carries the galvanometric helix formed of fine wire and constituting the movable bobbin. It will be seen (No. 2) that this helix, C, is suspended by two threads that pass over the pulley, P, and that two other wires, running to R, maintain it at the bottom. The tension of these threads is regulated by means of the screw, V. Two horizontal threads connected with the screws, T, traverse the first and limit the torsional motions. In the vacant space of the helix, C, and so arranged as to allow it entire liberty of motion, there is an iron cylinder, I, fixed against the support and designed to concentrate the lines of force of the magnet. The extremities of the wire that forms the bobbin, or galvanometric helix, C, are connected with the terminals, F, which communicate with the earth and the cable. The currents that traverse the apparatus tend to break the position of equilibrium of the helix and give it oscillatory motions to the right or left, according as they are positive or negative. It is these oscillations that it is a question of registering. To this effect, there is fastened to the upper extremity of the helix a small siphon, S, formed of a very light capillary tube made of glass, and the shorter arm of which dips into a reservoir, E (No. 1), filled with a very fluid ink which the longer arm discharges upon a paper tape, P, unwound by a clockwork movement and guided by a support, M.

In reality, the ink does not always flow of itself, and it is especially by the arrangements employed to make it do so that the various systems differ. The processes to which recourse is had are based, some of them, upon the passage of a local current flowing from the ink reservoir to the paper, and others upon vibrations communicated to the siphon, but a description of such systems would carry us too far and form the subject of a special article. We shall admit for the present that the ink flows. When the tape unwinds in a regular manner, the siphon will trace in its center a straight line as long as the apparatus is immovable, but at every passage of the current the siphon will be deflected to one side or the other, and such motions will be shown upon the paper by sinuosities situated to the right and left of the median line. In returning to the same principle as for the reading of the mirror, it will be understood that these curves may be assimilated to the Morse code. The dots are represented by the apices of the curves situated toward the top of the tape, and the dashes by those of the bottom. The analogy between the two alphabets is, therefore, easily established for the reading. In practice, it is a little more difficult, since the motions of the siphon, which are more jerky, do not, by a long way, permit of obtaining regularity.

There is about the same difference as there is between a specimen of fine penmanship and the writing of a page of notes taken during a lecture. So it requires a great deal of experience to be able to read a dispatch written by the siphon recorder, but one can at least take his time.

It will be seen that the apparatus for transatlantic telegraphy, although much improved, still leave much to be desired, but the feeble currents at our disposal, and the phenomena of induction brought about by the conditions under which the line is situated, allow of slight hope that it will some day be possible to register dispatches by means of the apparatus usually employed upon continental lines.—La Nature.



AN IMPROVED SIPHON RECORDER.

1, general view of the apparatus; 2, details of the siphon and galvanometric helix.

QUICK METHODS OF TESTING FOR FAULTS IN ELECTRIC WIRING.*

By A. E. HUTCHINS.

WE will start with a complete system of wiring, say for a large office building, hotel or factory, where a complete equipment of multiple (two-wire) system of electric wiring has been installed, with generating plant included, and cutouts and fuses and switches placed and connected, also instruments (for governing and regulating dynamos and plant) placed on switchboard. The house wiring will consist of a number of feeders or risers running from the bus-bars on the switchboard of the generating plant or dynamo-room, and thence to different sections and stories of the building, or buildings, where they severally end at distributing or cut-out boxes, where a number of branch, or lighting and motor, or electric heating circuits converge or get their supply. The feeder or riser circuits are also connected at or near the feeder ends with a set of wires we will call helper or equalizer wires, that are run from one feeder to another and another, and so on, for the purpose of providing a means whereby one feeder, if over-burdened with current, may be, through these equalizer wires, assisted from another feeder or feeders, and so borrow or lend. Not to have too many complications, we will employ one set of tell-tale wires running from the principal feeder and back to the switchboard. The electric fixtures and drop lights have been put up and connected and lamps are in. Fan and other motors ready to run and electric heating apparatus are connected. The buildings are also equipped with gas, steam, and water conductors.

A man is sent to start the electric generators and give the plant a trial run. We will say that he has undertaken to run it and finds that nothing will work. We will say he then calls upon the reader and myself to first dissect the wiring and see where the trouble or difficulties lie. To start in, we will first disconnect different feeders at the switchboard of the main bus-bars, and then we will connect the terminals of a magneto (first used to test with) to one set of feeder wires, remembering that if the two leads of the feeder are cross-connected by a conducting channel anywhere else than the winding of the magneto, then by turning the magneto (or generator) the magneto bell will ring. We will now see that all the incandescent lamps in the entire building are disconnected, as their filaments afford a path from one side of the feeder to the other. We will next open the various motor or heating circuits, and if we still get a ring by the magneto we may ask, isn't there still another normal channel for the current to pass in a circuit? as we are looking for normal causes before looking for abnormal. What about those two tell-tale wires leading back to the indicator or voltmeter in the dynamo room? As a voltmeter, it is connected across the polarities of the circuit, and so we next disconnect those wires at the instrument, and if we still get a ring, and no other normal channels or paths for the circuit are to be found, we look for crosses or trouble elsewhere.

Recollecting that this one feeder, to which the magneto is still connected, is connected with all the other feeders by means of the equalizer or helper wires, we will first disconnect the different feeders at the feeder ends, to cut out or disconnect all communication with their branch circuits, and then, by trying the magneto and getting no ring, should we conclude that the coast is clear so far as feeders and equalizer wires are concerned? No, not until we go back to the main bus-bars, and after disconnecting dynamos and instruments from the bus-bars, then connect or switch in the feeders, one by one, and if you get a ring from the magneto on connecting any of them back to the bus-bars again, you will then discover that though separately each feeder wire is properly connected to the like polarity of bus-bar, yet a mistake has been made by one or each lead of the equalizing wire connecting the opposite instead of the same polarity of feeder wire, and thus making what is called a cross. Now connect branch wires at their feeder ends, and if all test out clear or free from any cross, we then test the entire wiring system to the lamps at once for a ground by connecting but one terminal of the magneto to both polarity wires of the feeder and the other terminal to a water or gas pipe as a common ground. If any contact or ground occurs at any point or ramification of the system, the bell will ring and tell the tale for the entire system at once—that there is a ground or "bug" somewhere. Then, by testing at feeder ends separately (isolating that feeder from the others) you proceed to separate the various circuits and test separately till identifying the grounded or, as the case may be, the crossed circuit through different (or double) grounds. Of course, if a wire is grounded on a fixture (chandelier), being insulated from the main pipe by an insulating joint, then that ground has to be located separately.

Now, when we have cleared all the grounds and crosses, if any, we may look to see if each individual light or outlet has proper and through electric service from the cut-out box at the feeder end. Proceeding to connect the magneto to feeder end and branch wires, we touch the wires at the outlets, or close the circuit in the lamp socket of the fixtures by inserting a metallic tool, and by getting a ring from the magneto, we demonstrate a true circuit. If the magneto is beyond hearing distance, then allow the current from the magneto from the outlets or ends of the wires to pass through your thumb and finger, or put your finger end up in the lamp socket instead of the tool, and you will feel when the current is there. If a wire is broken so that you do not get current, then by grounding separately each wire at one end and by grounding the other end through the magneto, if it rings from but one wire, and if you have connected to the proper wire at the cut-out box—then one of the wires is identified as broken, or is run to another or wrong outlet, but it may in like manner be so identified. If no gas or metallic piping is accessible to ground on, then the circuit may be completed through an extra wire provided as a temporary leg from the magneto to outlet.

In a case where a confusion of wires is found—as at a place for general distribution, thence concealed from view till appearing at the other ends or outlets—the quickest way to pair them off into circuits is to connect the terminals of the magneto to the outlet for light or motor (or with a flexible wire or cord to attaching plug) and to the screwed-in lamp socket in a fixture. Test with your fingers the ends of the wires in the cut-out box, and when you feel the current you know you have got the proper wires running to that outlet, so they may now be rightly connected to the proper cut-out if desired. If you have a live current (low tension) to test with at cut-out box, a very convenient method of identifying the wires and pairing them into circuits is to close the ends of the wires at one outlet at a time, as before, and then go to the cut-out box, connect with live current from fused cut-out one wire of lighting circuit, and then, with one hand on the other polarity of the live current wire (perhaps from off a main binding post of the unfused cut-out), take the other hand and feel the ends of the wire to be tested or identified

* Western Electrician.

(i. e., close the circuit through your person). If you feel a current through your body, you will know you have identified the circuit, or else another contact or cross is discovered instead, and you cannot thereby blow a fuse or a plug, as the resistance of your body protects the fuses and does not harm the person.

A very quick method of identifying grounded wires is also by feeling or closing the current through the hand as a testing instrument. If testing this way by use of alternating (secondary) live current, great care should be taken lest the transformer be defective and make yourself liable to get a dangerous shock from off the primary or high-tension wires, as you may get a shock (from a little dampness in transformer), due to the primary wires being grounded outside. It must also be remembered that as some meters have a high resistance winding that contacts or closes the two polarity wires on which it is placed, it must not be mistaken for a cross on the lines in testing.

When cut-outs or fuse blocks are in place, but plugs or fuses are not in, before fusing them up, if live current is present in the cut-outs, close or bridge one plug or fuse opening, with a metallic tool, pliers or screw-driver, and by closing the other plug socket or contact screws, by sticking your finger into the plug socket or by spanning the open place for a fuse wire with thumb and finger, you can quickly find if there is a cross on any of the circuits and yet not burn out a fuse. In testing out a three-wire system, on dead wires, those intended for positive and negative wires may be bunched together to be attached to one terminal of magneto or a testing battery, and the neutral bunch of wires to the other. The reader is aware of the use of various galvano-meters and the Wheatstone bridge for greater precision in locating faults. A voltmeter is also a very serviceable instrument in testing by use of live currents, its greater or lesser deflections showing in a practical way the stronger or weaker grounds or crosses that occur through dampness, wet conduit tubes, etc.

Mistakes sometimes occur by wiremen when they cut in two double-pole switches on a three-wire branch circuit from two (one-way) branch cut-outs, as the two adjacent terminals in two neighboring cut-outs are of opposite polarity and by mistake they use them, or try to, as a neutral wire, and hence a cross occurs. Sometimes the wires from different cut-outs supply one fixture, and by mistake are connected so at the switches that one polarity from each cut-out passes through one double pole switch and the other polarity through the other switch, so that one switch turns on no lights, but the second one turns on all, or vice versa.

EXPRESS COMPOUND LOCOMOTIVE, IMPERIAL-ROYAL AUSTRIAN STATE RAILWAYS.

THE powerful compound locomotive illustrated in the present issue may be taken as the most advanced type of express locomotive in Austrian practice. In general external appearance it bears some resemblance to the Italian express engines of the Strade Ferrate del Mediterraneo, combined with the prominent characteristic of M. Polonceau's Paris-Orleans locomotives; duplicate steam domes, connected by an outside dry pipe. It belongs to what is known as the "Series 6," designed in 1893 by Mr. Karl Gölsdorf, locomotive superintendent of the Austrian State Railways, and of which type there are now 46 locomotives in regular service upon the important sections of Vienna-Eger, Vienna-Prag and Vienna-Salzburg. These engines haul the Oriental Express over the Vienna-Linz route —Paris to Constantinople. On these sections the ordinary express trains average fifteen to eighteen coaches, or, say, 240 tons, to which the locomotive and tender add 93½ tons, or 333½ tons in round figures. With such loads the practice of compounding should be productive of appreciable economies, but Mr. Gölsdorf was inclined to the dictum—emitted some years ago by the venerable M. Polonceau and since become famous—that there would be little economy in the long run, when the complication of added mechanisms would tend to distract the driver's attention from his lookout duties at critical moments, and that the driver already had sufficient to attend to without adding more to his manual operations. The Austrian engineer, however, although admitting that the Continental driver must be more intelligent and better paid to manipulate the extra parts necessary for the starting of compound machines, sought to build engines having compounded cylinders, but without any added gears for starting, beyond those generally employed for the steam distribution in single expansion locomotives.

The engine under notice is powerful, as will at once be judged by its grate area of 31·2 square feet, and its fire box heating surface of 118·3 square feet—which is little short of that in the square top Belpaire fire boxes of the Belgian State Railways—while its total heating surface of 1,673 square feet considerably exceeds that arranged for in any single boiler express engine employed in Belgium and France, and its boiler as a reservoir for steam at a normal pressure of 191 lb. is increased by two capacious domes and their connecting trunk, a practice of augmenting the clothed surfaces projecting from the boiler and impinged on by the cold air, which is, nevertheless, not considered to occasion any loss of heat.

The boiler is of exceptionally large diameter, even for a Continental express engine, the outside diameter of the back ring, 55·8 in., having been made permissible by raising the axis of the boiler to 8 ft. 5½ in. above the rails, and clearing the driving wheel flanges. This elevated center of gravity, which is within 6 in. of that of No. 999 of the N. Y. C. and H. R. RR., serves also to lift the ashpan clear above the trailing coupled axle. The fire box, back plate and shell, being inclined outward to the foundation ring, a maximum length of 8 ft. 10 in. is attained within the fire box shell, which approximates to the length of Belpaire fire boxes used on Belgian lines.

The tubes, 14 ft. 5 in. long, although considerably exceeding in length those of Belgian and most French locomotives, are still much shorter than the flues of Paris-Orleans boilers—16 ft. 10 in. Including smoke box, the barrel is 18 ft. 2 in. long; while, over all, the whole generator measures 27 ft. 8 in. The boiler sheathing is discontinued at the smoke box. Owing to the great height of the boiler, the cab windows have had to be placed low to each side of it—a convenient arrangement in roomy cabs having, as this engine has, an inside width of 8 ft. 4 in.

The reversing gear is worked by a screw, and the regulator in the forward dome by a lever against a sector disposed in the manner of most reversing levers. No special starting valve is used; but steam inlets are bored in the faces of the low pressure steam chests and controlled by a special form of slide valve. The circular fire hole ring is closed by a door whose hinge pin is continued upward and formed into a very convenient handle with wooden end.

A front bogie truck, having 8 ft. 10 in. between its axle centers, is a fine leap from the ordinary practice, the conditions fully permitting its application; and this long base of the truck wheels, while well within that of the drivers, adds necessarily to the smooth running of the engine, and lessens the work on the bogie pin by reason of the increased base of triangle of which the pin is the apex. In regular service trains are taken round curves of 414 yards radius at a speed of sixty miles an hour. The bogie pin is placed 9½ in. behind the middle of the cylinders, in a position where the counterthrust of the pistons is somewhat less rigidly withstood than when the pin is set farther in advance of the source of disturbance.

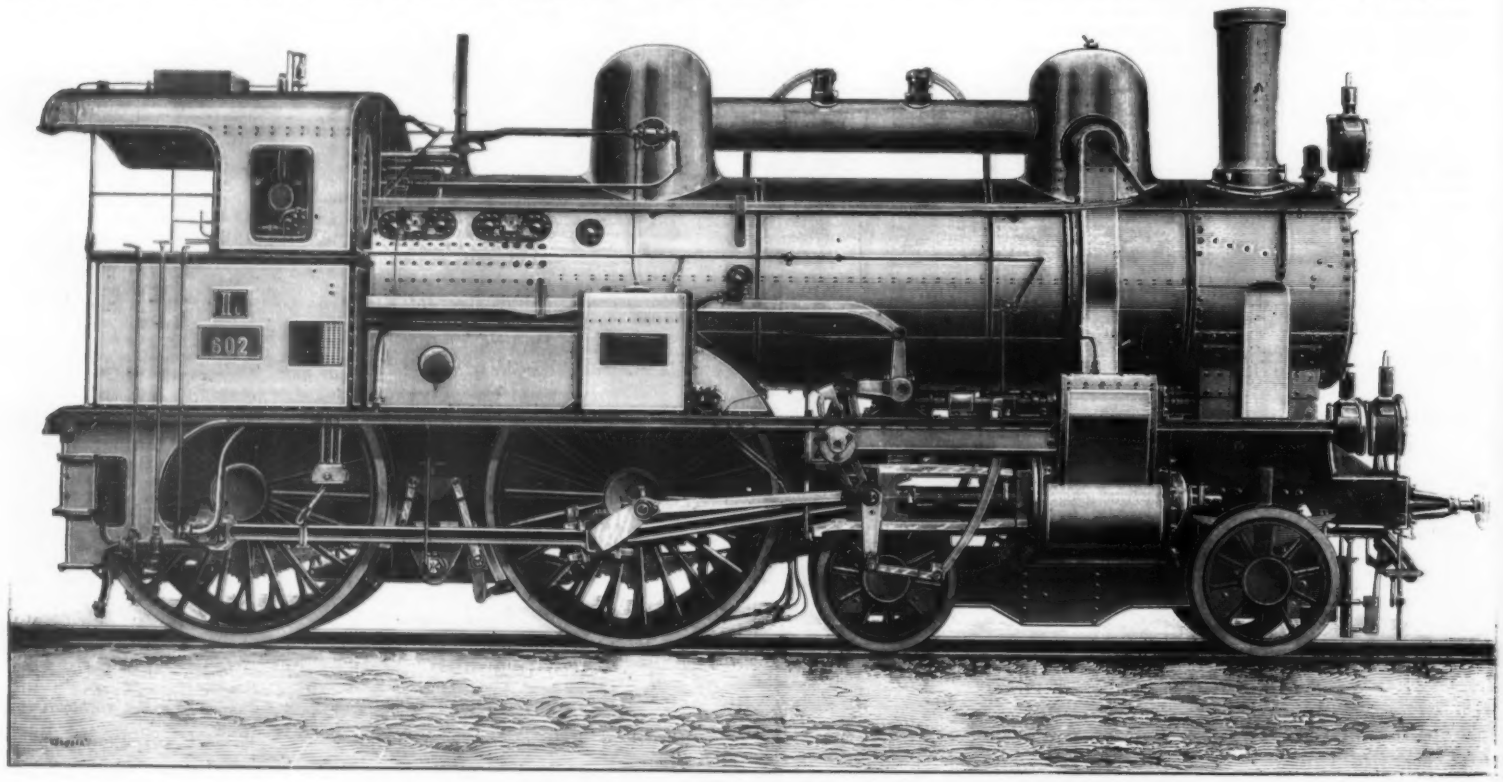
In regular service these engines take loads of 240 tons, exclusive of locomotive and tender, up rising gradients of 1 in 100 at 25 to 28 miles per hour, and on gradients of 1 in 200 at 40½ to 44 miles per hour.

On another section—Vienna to Eger—trains of 135 tons, omitting weight of locomotive and tender, are hauled at 40½ to 44 miles per hour on gradients rising 1 in 100; and the same train on level ground, and on inclines of 1 in 500 to 330, at 56 to 59·4 miles per hour. The coal—Astrau—consumption in such work is about 26 lb. per mile, the steam generated being 6 lb. to 6½ lb. per pound of coal. On the same line, at the average speed of 39 miles per hour, the steam consumption is 19·1 lb. per horse per hour.

In some experimental trials with two coaches only, speeds of over 81 miles per hour were made on levels, and with 140 tons behind the engine, the speed of 67½ miles per hour was attained. At indicated powers of 900 to 1,000 horses the steam consumption was about 21 lb. per horse per hour. A relief valve on the receiver pipe unseats at pressures of over 80½ lb.; its cover, visible in front of the chimney, is perforated with two holes for the escape.

After a service of three years no trouble has been experienced with the valves or seatings. Their appearance is always excellent, and the perforations in the valve face of the low pressure cylinders, as well as the rib in its valve slide, remain perfectly steamtight at nominal cut-offs of 50 per cent., and the live steam inlet tubes, as well as the apertures themselves, show nowhere a trace of deposit. The moving parts of the locomotives seen on the outside are finished bright, but with this exception there are no polished fittings, the engine being painted a uniform black, picked out with red lines. The chief dimensions are as follows:

Running gear:	
Driving wheels (4), diameter	6 ft. 11½ in.
Truck wheels (4), diameter	3 " 4¼ "
Tender wheels (6), diameter	3 " 4¼ "
Journals, driving axles	7⅞ × 10½ "
Journals, truck axles	7⅛ × 9⅜ "



EXPRESS COMPOUND LOCOMOTIVE, AUSTRIAN STATE RAILWAYS.

Cylinders, 19⅜ inches and 29 inches diameter by 26¾ inches stroke; diameter of drivers, 6 feet 11½ inches; steam pressure, 190 pounds; heating surface, 1,673 square feet; weight, 122,304 pounds.

Wheel base:	
Driving	9 ft. 2 in.
Truck	8 " 10 "
Total engine	23 " 10¾ "
Weight in working order:	
On driving wheels	63,392 lb.
On truck wheels	58,912 "
Engine, total	122,304 "
Tender, total	83,776 "
Engine and tender, loaded	206,080 "
Cylinders:	
Size of high pressure	19⅜ × 26¾ in
Size of low pressure	29 × 26¾ "
Piston rod, diameter	3¼ in.
Boiler:	
Diameter of barrel inside (largest ring)	4 ft. 9 in.
Thickness of barrel plates	⅞ in.
Height from rail to center line	8 ft. 5½ in.
Working steam pressure	190 lb.
Firebox:	
Length inside	8 ft. 3½ in.
Width inside	3 " 8½ "
Depth at front	5 " ¾ "
Depth at back	3 " 9 "
Thickness, side and back plates (copper)	½ and ⅝ in.
Thickness of tube sheet (copper)	½ " 1 "
Grate area	31·2 sq. ft.
Tubes:	
Material, steel, No	205
Diameter outside	2 in.
Length between tube plates	14 ft. 5 in.

Heating surface:
Tubes.....1,554·8 sq. ft.
Firebox.....118·3 " "

Miscellaneous:
Smokestack, height from rail to top.....15 ft.
Capacity of tank.....4,422 gal.
Capacity of coal space.....11,650 lb.

We are indebted to the Engineer for illustrations and particulars.

WORK DONE BY WHEELMAN AND PEDESTRIAN.

By H. K. LANDIS, E.M.

In the seances of the French and German medical societies the effect of cycling on general health is frequently discussed, and arguments advanced both pro and con. As they consist, however, in the exchange of individual opinions principally, and in conclusions arrived at from insufficient data, they will not be further touched upon. There is one exception, however, in the experiments ordered by l'Academie de Medécine, under the direction of M. Marey, and executed by M. Bouny, on the board track of the Velodrome d'Hiver, at Paris, and which have been described in the Comptes Rendus of the Academy of Sciences, June 15, 1896. Although the general results reported are not strictly in accordance with those of Jaquot, Guye, Barrow and others, yet there was a diagram presented which admits of more complete discussion than was given to it. The analysis of Fig. 1 is an amplification of this diagram, which was made at a velocity of 13 miles an hour, being the mean of five revolutions of the crank, by means of a pedal dynamometer registering both sliding and direct pressure on the pedal. These components were united, producing a resultant thrust, as cd, in position 4, Fig. 1. If we develop the crank circle, we will have the straight line, hh', Fig. 2; upon this we will erect the ordinates of equal length to t..e successive darts or foot thrusts, which are limited by the curve, ff', for the right foot, and curve, ee', for the left foot. By adding these ordinates we obtain the curve, bb', of the sum of pressures on both pedals. The weight of one leg of a 160 pound man is about 20 pounds; if we subtract this from the pressure of either foot, we obtain the muscular pressure alone, which, in this case, was never less than 10 pounds. By subtracting 40 pounds, ee', from the ordinates of curve, bb', we obtain the ordinates, for each successive position, representing the total muscular pressure on pedal. Referring now to Fig. 1, let us separate the thrusts, cd, into tangential (ce) and radial (de) components, the first being effective pressure producing rotation, while the latter simply means pressure on the crank snaft bearing. If we now use these as ordinates and erect on ll', Fig. 2, we get the curves, lll' and kkk', for right and left crank, the ordinates below, ll', representing negative tangential pressure, produced by unconscious back pedaling. Adding these pressures algebraically, we have a curve, kmk', to represent the effective tangential component of the total pressure, bb'.

The shaded area, kl', represents the effective work, which, of course, is equal to the resistance to motion. On this basis the calculations of M. Bouny were made, though he neglects giving any details whatever. Let us assume the length of crank of a standard machine to be 6·75 inches; this will produce a crank circle of 1·76 feet. The foot pounds expended per half revolution of crank, M. Bouny gives as 37·64. Let P = the average pressure; then 1·76 P = 2 × 37·64, or P = 43 lb. The average ordinate of kmk' is JJ', which must equal 43 lb.; with this scale we are able to give aa', dd', tt' and ww' their values in pounds. If we now construct upon the base line, zz', the curves, xx' and vv', the latter being the curve of muscular pressure, i. e., bb' less ee', we will see that the difference represented by the shaded area, vv' x'x, will be lost work. As the average effective pressure under the given conditions was 43 lb., and the average muscular exertion, measured in pressure, was 126 lb. less 40 lb., or 86 lb., we see that by a curious coincidence the effective pressure is just half the effort exerted by the rider.

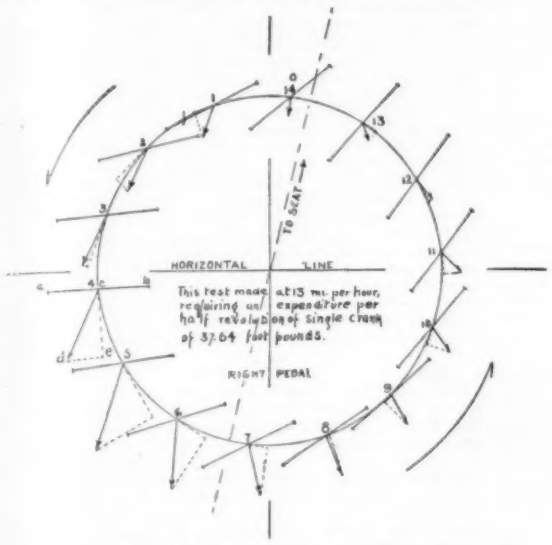

HORIZONTAL LINE
RIGHT PEDAL
To SEAT
This test made at 13 mi. per hour, requiring an expenditure per half revolution of single crank of 37.64 foot pounds.

FIG. 1.—ANALYSIS OF PEDAL PRESSURE BY M. BOUNY.

a b = position of pedal; c d = relative intensity of pressure; c e = tangential component; d e = radial component.

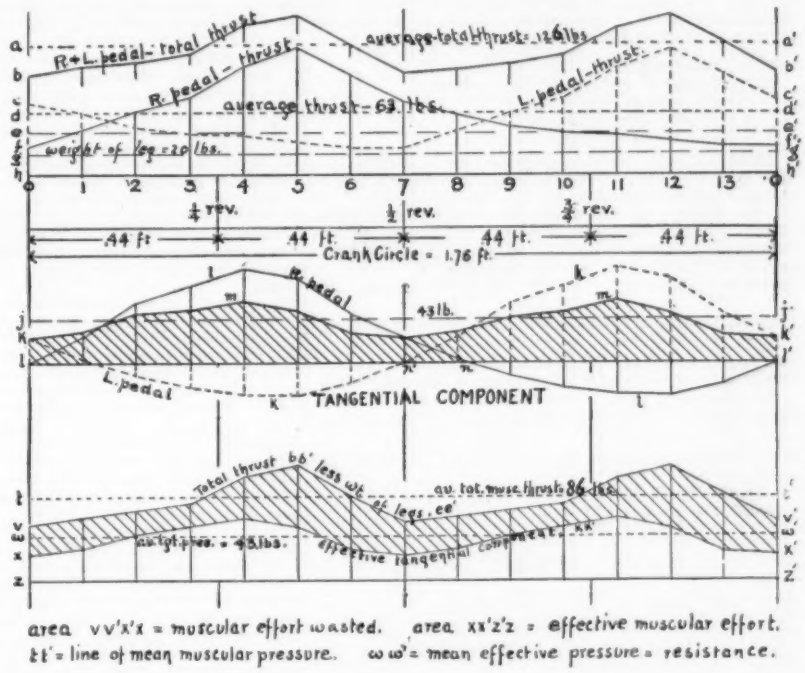

R+L. pedal - total thrust
average total thrust = 126 lbs.
R. pedal - thrust
average thrust = 63 lbs.
L. pedal - thrust
weight of leg = 20 lbs.
¼ rev.
½ rev.
¾ rev.
44 ft.
Crank Circle = 1.76 ft.
R. pedal
43 lb.
L. pedal
TANGENTIAL COMPONENT
Total thrust bb' less wt. of legs ee'
av. tot. muscular = 86 lbs.
av. tot. pressure = 43 lbs.
effective tangential component
area vv'x'x = muscular effort wasted.
area xx'z'z = effective muscular effort.
tt' = line of mean muscular pressure.
ωω' = mean effective pressure = resistance.

FIG. 2.—ANALYSIS OF FOOT PRESSURE ON PEDAL, BEING A DEVELOPMENT OF FIG. 1.

In other words, a wheelman does just twice as much work as is necessary to drive the machine. It will be seen by curve, kk', that there is no "dead center" and that the driving force is quite regular, at least more so than usually supposed. In Fig. 1 a decided backward pull is apparent in positions 6 and 7, which carries the other foot over the approximate "dead center" existing near position 14.

While making some experiments to verify the statements made by certain English engineers as to the traction and work necessary in bicycle propulsion, it was clearly demonstrated that existing data possessed agreement neither with the writer's results nor with any other contemporaneous experiments. It was therefore decided to develop an expression independently both in method and data, and the result were the following formulas:

$$T = 0{\cdot}003 f W (1 + 0{\cdot}01 V^2) + 0{\cdot}005 V^2 A$$

$$H.P. = 0{\cdot}0027 TV$$

T = traction — lb.
W = weight of wheel and rider — lb.
f = coefficient of roughness.
V = velocity miles per hour.
A = effective air surface — sq. ft.
H. P. = horse power.

In the preceding experiments $f = 1$; if we let in addition W = 136, A = 4, and V = 13, we will secure by this formula a value of T as 4·46. The machine used by the writer in the tests, a Columbia model 40, travels on hard inflated tires 8·4 ft. per half revolution of crank, which, according to M. Bouny, equals a work of 37·64 ft. lb.; or 8·4 T = 37·64, from which T = 4·47 approximately as above, so that we know about under what conditions the test was made. For asphalt $f = 1{\cdot}7$, and for country macadam $f = 8$. Using the data previously given, where the weight of rider was 113 and weight of wheel 23 pounds, and granting that for all velocities and persons half the power only is effective (an assumption not yet verified by experiment, though probably not far in error), we obtain the table below.

By an inspection of Fig. 3 we are able to appreciate how not only the effective but the waste work increases with values of f, for at 15 miles per hour we have attained an impossible exertion on sandy road. Various authorities say a day's work for a laborer is the exertion of 0·1 horse power for ten consecutive hours. This would bar out sandy road entirely and allow a speed on rough macadam of 5 miles and on asphalt of 8 miles per hour for ten hours. Zimmerman, in one of his best races, exerted 1·2 effective horse power while going at the rate of about a mile in 1·6 minutes, which we may

TABLE I.—MUSCULAR EFFORT OF WHEELMAN.

V Miles per Hour.	Horse Power.			
	Effective.		Total.	
	f=1·7	f=8.	f=1·7	f=8.
1	0·002	0·009	0·004	0·018
2	0·004	0·017	0·008	0·034
3	0·007	0·029	0·014	0·058
4	0·012	0·044	0·024	0·088
5	0·018	0·058	0·036	0·106
6	0·027	0·080	0·054	0·160
7	0·038	0·108	0·076	0·216
8	0·052	0·134	0·104	0·268
9	0·069	0·175	0·138	0·350
10	0·092	0·223	0·184	0·446
11	0·113	0·270	0·226	0·540
12	0·147	0·333	0·294	0·666
13	0·185	0·409	0·370	0·818
14	0·228	0·498	0·456	0·996
15	0·272	0·580	0·544	1·160

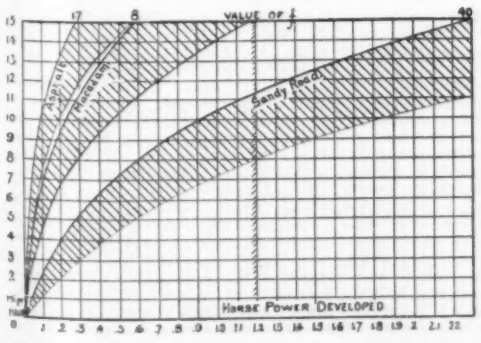


FIG. 3.—POWER EXERTED AND UTILIZED BY WHEELMAN—SHADED AREA REPRESENTS WASTED MUSCULAR EXERTION.

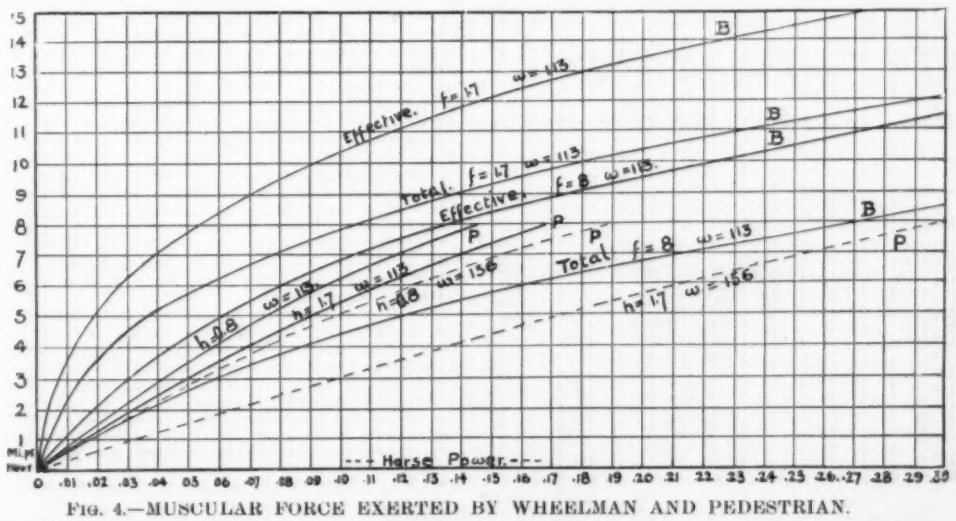


FIG. 4.—MUSCULAR FORCE EXERTED BY WHEELMAN AND PEDESTRIAN.

B = curves for wheelman; P = curves for pedestrian; w = weight of either in pounds; f = 1·7 and 8 corresponds to asphalt and ordinary macadam roads.

regard as about the limit of speed and power of a wheelman. Therefore, 11 miles per hour is the limit of speed on sandy road, while on macadam road but one-fourth that power is required at the same speed, and but one-tenth on asphalt. Mendelsohn considers 37 miles per hour as excessive. M. Loewy, from experiments on a winding stairs, concludes that the exercise of 0·92 horse power was not fatiguing. This would mean total muscular exertion, and would mean a speed on macadam of 13 to 14 miles per hour. He however compares it to the work done by a cyclist going up a 3 per cent. grade at 11·8 miles per hour, in which he exerts but 0·32 horse power.

Let us now examine into the work done by a pedestrian. The act of walking consists of successively leaning forward and straightening up, accompanied by a push of the rear foot and a straightening of the forward leg. The muscular exertion here required is in the slight push alluded to, the lifting of the lower leg, and the raising of the entire body through the distance its center of gravity has fallen while leaning forward. We will designate

w = weight of pedestrian—lb.
h = vertical fall and rise of body—inches.
l = length of step—inches.
V = velocity—miles per hour.
A = air resistance surface—sq. ft.

Rigid accuracy must not be looked for in a discussion of this kind, owing to the extreme variability of factors due to the personal equation of the pedestrian; but we can deduce an expression showing relative values which will be sufficient for our purpose. Let us assume the average weight of lower leg as 0·17 w; the foot to be raised 3 inches at beginning of return, or its center of gravity 1·5 inches. The foot pounds developed per step will therefore be $0{\cdot}17\ w\ \frac{1{\cdot}5}{12} = 0{\cdot}02\ \ w$;

we can safely assume 0·75 lb. as the value for the forward push, or 0·005 w ft. lb., making a sum of 0·025 w. At each step w is raised through $\frac{h}{12}$ feet exerting $w\ \frac{h}{12}$ ft. lb., which added to the other work gives us per step:

$$0{\cdot}025\ w + w\ \frac{h}{12} = w\left(\frac{h}{12} + 0{\cdot}025\right) = \frac{w}{12}(h + 0{\cdot}3)$$

As $\frac{l}{12}$ is the length of one step in feet, there will be

$$\frac{5280}{\frac{l}{12}} = \frac{5280 \times 12}{l} \text{ steps per mile, or } \frac{5280 \times 12}{l}\ V \text{ steps}$$

per hour. Our expression then becomes: $\frac{w}{12}(h + 0{\cdot}3)$

$\frac{5280 \times 12}{l}\ V$ ft. lb. per hour, or $\frac{w}{l}(h + 0{\cdot}3)\ 0{\cdot}0027\ V$ horse power, after canceling and dividing by 60 × 33,000. As H. P. = 0·0027 TV, $T\ \frac{w}{l} = (h + 0{\cdot}3) =$ equivalent traction. This last expression may seem somewhat nonsensical, but if a spring balance is attached to an average man, the pull necessary to cause him to walk, he being perfectly passive, will be found to agree pretty well with this formula. Its object is principally as an equivalent to bicycle traction. By comparing the two we see that while with the same person, bicycle traction depends upon f and V, equivalent pedestrian traction depends upon l and h. The former depends upon outside conditions, while the latter depends upon personal characteristics.

Air resistance is a small factor, but we will introduce it to make the expression complete. The United States Coast Survey uses the expression $P = \frac{V^2}{200} A =$ total pressure in pounds on A square feet area when the wind blows at V miles per hour. Suppose the air to be quiet, and the wheel to move at V miles per hour, we get the same result, which we must add to traction, thus: $T = \frac{w}{l}(h + 0{\cdot}3) + 0{\cdot}005\ V^2\ A$, and then

$$\text{H. P.} = \left[\frac{w}{l}(h + 0{\cdot}3) + 0{\cdot}005\ V^2\ A\right] 0{\cdot}0027\ V.$$

Let us assume an average of l = 26 inches and A = 6 square feet. We can then calculate the horse power required at various velocities, assuming that h and l remain constant; this last assumption is not strictly accurate, but sufficiently so for our purpose, for as l increases h increases with it, and the ratio is probably not much affected.

TABLE II.—HORSE POWER EXERTED BY PEDESTRIAN.

V Velocity in Miles per Hour.	w = 136		w = 113	
	h = 0·8	h = 1·7	h = 0·8	h = 1·7
0·5	0·009	0·016	0·006	0·008
1·0	0·018	0·032	0·013	0·016
1·5	0·027	0·048	0·019	0·021
2·0	0·035	0·065	0·027	0·032
2·5	0·046	0·081	0·037	0·040
3·0	0·054	0·097	0·040	0·050
3·5	0·065	0·108	0·047	0·060
4·0	0·075	0·132	0·058	0·068
4·5	0·086	0·153	0·065	0·078
5·0	0·099	0·172	0·076	0·091
5·5	0·110	0·190	0·086	0·100
6·0	0·124	0·210	0·097	0·113
6·5	0·137	0·227	0·105	0·125
7·0	0·152	0·251	0·113	0·139
7·5	0·167	0·270	0·132	0·151
8·0	0·189	0·300	0·144	0·166

These results, along with those of Table I, are plotted as curves in Fig. 4.

If we take 4 miles per hour as the average speed of a pedestrian, the horse power he exerts is between 0·058 and 0·132. If the average speed of a wheelman were 10 miles per hour, he would exert a total effort of 0·184 to 0·446 horse power. Taking a mean value between these working extremes, we would have a ratio of effort of pedestrian to wheelman of approximately 1 to 3. If we compare the effort of a wheelman at 4 miles per hour, which is probably the lowest practical velocity, we find the ratio of effort of pedestrian to wheelman to be, at the same speed, about 2 to 1. Consequently, although a wheelman exerts three times as much effort in equal times at average speeds, a pedestrian exerts twice as much effort in traversing equal distances. Zuntz and Katzenstein give data which indicate that at 4 miles per hour a pedestrian develops 0·141 horse power; M. Loewy says 0·145 horse power for several hours; Smeaton states that the equivalent of a day's labor is at the rate of 0·114 horse power, which is probably not far from the effort exerted by an average man; walking for 10 hours would, therefore, constitute a day's work when 40 miles were traversed, while a bicycle would travel 80 miles when the wheelman was doing the same work.

By an inspection of Fig. 4 it will be seen what influence the variable factors have on the effort exerted between the limits of probable working extremes. A horse power is the exertion of 33,000 foot pounds per minute and must not be confounded with the power of a horse, which, according to Trautwine, is but 22,000 foot pounds per minute. From the table it is evident that the rate of increase in effort is greater with a pedestrian than a wheelman at the customary speed of each.

CHAMPAGNE.

ALTHOUGH, in considering wines, the crown may be awarded to Johannisberg for its spicy flower, to Tokay for its fine aroma, to Château-Yquem for its sweet fire, or to Malaga for its delightful richness, it is certain that champagne surpasses them all in popularity, reputation and the extent to which it is used. It has inspired the most brilliant songs of the poets, the fair sex is fond of it, it is, as the French say, "the wine of the king, and, therefore, the king of wines." But it has not enjoyed this high place of honor very long, although Brillat-Savarin, the celebrated epicure, states in his "Physiology of Taste" that champagne was first made in the fourteenth century, and in a few weeks was granted first place among wines. It became known at the banquets which King Charles VI, of France, gave in May, 1397, at Rheims, to the Roman Emperor and Wenzeslaus, King of Bohemia, who had come to make a treaty with him, and who were so pleased with the heretofore unknown wine that they and their followers made merry with it day after day for a month. But this fragmentary account stands so entirely unsupported that it is quite reasonable to set it down as apocryphal, a fable which one would gladly accept as a bright incident in serious history. Perhaps that tempting wine was a good vintage of ordinary wine without sparkle from the chalk cliffs of the Marne, for it is certain that bottles were seldom used until the eighteenth century, and corking was unknown; when the latter became necessary stoppers made of oiled hemp were used. The first use of the cork led to the discovery of champagne, and is ascribed to Don Pérignon, cellar master of the Abbey of Haute-Villers, who held his office between the years 1617 and 1715. In 1718 champagne was mentioned in print for the first time, with the remark that it had been known for twenty years. It was called "pétillant" (sparkling) and "cork driver," or "devil's wine." It was then believed that it was prepared by some mysterious method by the aid of sorcery, and only the bravest dared take this effervescent drink. This fear did not last long, however.

The secret of its manufacture was carefully guarded by the monks of Haute-Villers at first, but was discovered as soon as the use of glass bottles and corks for stoppers for the preservation of wine became general, for all young wine will generate carbonic acid when fermenting, and keeping it in this condition is simply a question of skill. Champagne is, therefore, a wine that depends on skill, and the pleasure that it gives is the best means of refuting the old theory, still held by a few in the wine regions, that a wine should be perfectly pure. Very few men have ever tasted absolutely pure wine; that is, wine made from the juice of one kind of grape.

The district in which champagne is manufactured is quite large, including nearly fifty thousand acres of vineyards, and the value of good land is remarkably high, $15,000 per hectare (about two and one-half acres) is not uncommon. In Versy the average price ranges from about $2,000 to $5,700; in Epernay, Pierry and Haute-Villers, from about $6,200 to $8,100; and in Avize, $1,900 to $2,800 per hectare. The best grapes for making champagne are the "plante dorée," the Black Burgundy, the Pineau, Mennier, the Gros Blanc and Petit Blanc (white champagne grapes), and a few others. The vines have to be carefully tended, and every three years the bearing wood must be buried, so that the vines always appear young. Stakes are provided for the stems, all shoots without blossoms are cut off, and those that are left are not allowed to grow the full length of the stakes. There is no restriction on gathering grapes in Champagne; every one can harvest when and as he will. Champagne makers generally buy the grapes on the vine and then have their own people gather them carefully.

The wine is left in the storehouses until March, when the bottling begins. A large outlay is incurred in purchasing the bottles—which are always prepared during the previous summer—for single houses use as many as fifty thousand bottles, and many require no less than six hundred thousand per year. Each house keeps its own bottle tester, an experienced man, who can tell by the sound, when the sides of two bottles are struck together, whether they are perfect and strong enough for use or must be broken. The bottles are well washed with water, and then brushed out with alcohol and closed with old corks so that neither dust nor mould can get in. When the bottles have been filled they are taken to an "atelier," in which five men are at work, who finish twelve to fifteen hundred bottles in a day, so that each minute two bottles pass through the hands of all five men. As the large houses send out several hundred thousand bottles per year, they, of course, have to erect several "ateliers" close together, so that this task can be completed within a month—a longer time is seldom allowed. Carefully selected corks must be used, and they cost from $15.50 to $19.50 per thousand. After the bottles have been corked they are placed in the fermentation storehouses, in stacks measuring from 16 ft. to 50 ft. in length by 3 ft. to 5 ft. in height, without supports or frames. They are arranged in layers two bottles deep, so that each bottle rests on a board pushed underneath, with its neck between the bottoms of two other bottles; the outer bottles are held firmly in place by wooden prisms. Such a wall of bottles is as firm as iron, but any bottle can be taken out without disturbing the others, and it is often necessary to remove separate bottles in order to ascertain whether the process of fermentation is progressing properly. As the heat of the season increases the wine begins to work, the carbonic acid expands and the empty space in the bottles disappears. Now comes the most critical period in the whole process of manufacture, when many of the bottles burst and the wine escapes.

If this loss does not exceed 8 per cent. in the month of August, the worst month, the manufacturer is satisfied; if it reaches 15 per cent., the wine must be cooled with ice or be stored in a cooler cellar; if it reaches 20 per cent., there is no remedy but to open the bottles.

Formerly many workmen were injured during these investigations and operations by the bursting of the bottles; so they are now provided with strong wire masks and leather clothing. At such times a champagne cellar resembles a battle field; there is an incessant cracking, splinters of glass fly to the ceiling or rattle on the floor, and there is the rushing of the flowing blood of the vine. Great damage is often done when the temperature rises suddenly and the necessary precautions have not been taken. During the months of September and October the wine gradually becomes quiet, and there is less and less breakage. The store or cellar is tightly paved and provided with outlet channels, by means of which the wine that has escaped from the bottles is collected in reservoirs for other purposes.

The operation that comes next in order is the removal of the sediment or deposit from the bottles. The bottles are unstacked, and each one is carefully examined; those that are found intact are thoroughly shaken, so that the sediment will be evenly distributed, and then they are placed mouth down in board frames provided with inclined apertures. The positions of the bottles are changed several times until they stand perpendicularly, with the mouths still down. The sediment that has collected on the corks is removed by disgorging. The bottles are carefully moved from the cellar to the "atelier," where the "degorgeur" stands with a tub in front of him, above which there is a barrel with a doorlike opening, in which stands a burning candle. The cork is loosened and flies with a report into the empty barrel, and the explosion also blows out the sediment; the man wipes off the mouth of the bottle quickly, corks it, and puts it aside. The work of disgorging requires skill, and is not without danger, because many of the bottles burst. The wine lost from the bottles during this process should not exceed 5 to 7 per cent. It is collected and used for making vinegar and cognac. Near the "degorgeur" sits the "opéreur," whose business it is to add the "liqueur." All champagne contains liqueur, which in very high grades consists only of a solution of rock candy made from sugar cane and the purest wine, and in ordinary grades, of sirup, wine and alcohol. Each manufacturer has his own way of making up his liqueur, which he keeps secret. The liqueur makes the wine stronger or milder, sharper or sweeter, according to the taste of the consumers. It is poured in either by means of a tin measure or of an ingenious machine, which puts exactly the same amount into each bottle without losing a drop. If the wine is to be colored, the coloring matter is added to the liqueur. The bottles are then filled up, by means of another machine, with clear, effervescing wine of the same quality, to which no liqueur has been added, whereby the loss of carbonic acid is made good. Next comes the corker, who inserts the corks—that have been prepared beforehand—by means of a machine: then the "ficeleur" ties them in with string, and finally they are wired with red hot wire. This completes the operations of the champagne manufacture.

The bottles are carefully washed, dried, and tested again as to their perfect clearness, and then the necks and corks are covered with tinfoil or wax, and the labels are pasted on. The principal houses do not use any label, being satisfied with the brand on the cork, which enjoys the protection of the law, so that imitation is extremely difficult in France, being punished with imprisonment and a high fine. Where a label is used, simple elegance is preferred to much decoration. The champagne bottles are next packed, after having been wrapped in paper, in boxes or baskets with straw.

In France, where champagne is used only with dessert, it is not liked either too strong or too sweet, the grades which foreigners consider inferior being preferred here. For Austria and Eastern Germany it is made specially sweet; and for Russia it is also made sweet and mild. England takes it with the least liqueur, for there a strong tasting wine with considerable body is liked best. There are three grades of champagne: the crémant, mousseur, and grand mousseur. The first, the crémant, is the lightest, having the least foam, only what resembles a light cream, hence its name; the mousseur is more effervescent, and runs over the mouth of the bottle when the cork is drawn; the grand mousseur projects the cork with a loud report and foams in the glass. Experiments with the manometer show that the mousseur must have a pressure from four to four and one-half atmospheres and the grand mousseur from four and one-half to five; wine that has a pressure of less than four atmospheres is classed as crémant. The pressure cannot be greater than six atmospheres, for if it reaches seven or eight atmospheres, the bottle bursts. A distinction is generally made between ordinary wine, which formerly went under the name of "sillery mousseux," and "grand vin" or "qualité supérieure," "vin royal," "impérial," "fleur" or "qualité exquise."

Champagne is given a light rose tint by means of

"fismes"—a coloring matter made in the city of Fismes, France. The brownish color, "œil de perdrix," is no longer used, and wherever it occurs it indicates an inferior wine. Very red champagne is sometimes prepared as a curiosity.

The main difference between champagne and other wines consists in the great amount of carbonic acid which it contains; part of this is absorbed in the liquid and part of it fills the space between the liquid and the cork, which latter it sends flying into the air if there is sufficient pressure. There is not a large amount of carbonic acid gas. As soon as the pressure on the wine is removed, little bubbles of carbonic acid rise, explode, and throw particles of the liquid into the air, forming a light vapor, that runs over the mouth of the bottle. It might be supposed that champagne which is subjected to a pressure of five and one-half atmospheres must quickly release its carbonic acid, but this is not the case, for the viscous fluid holds the gas for some time, releasing it gradually by effervescence. The bubbles of gas develop on the irregularities and projections on the surface of the glass, even when they are not perceptible to sight or feeling. Any porous body, like bread or biscuit, dipped into the wine causes an immediate effervescence. If the glass is held tightly in one hand and struck with the flat of the other hand, bubbles are immediately formed over its entire inner surface. If the glass is moved downward suddenly, the liquid will not follow as quickly and will be rarefied along the surface of the glass, whereby gas is freed. Champagne that has been fermented twice has been freed by disgorging from most of its albumen, but in case that which is left should threaten to form the basis for a third fermentation, the tendency must be overcome by the addition of alcohol and sugar. After receiving this special treatment, champagne usually remains clear and quiet, but the bottles must always be kept on their sides, so that no gas will escape, which invariably happens when they are stood up, no matter how well they have been corked. The amount of alcohol depends on the liqueur added to it, which, as already stated, varies according to the taste of the consumers. In a general way, it may be said that champagne contains, by measurement, 10 to 11 per cent. of alcohol.

The effect of champagne on the human organism is well known; it is quick and decided; it excites, pleases, refreshes, and enlivens as does nothing else, and its effect passes off just as suddenly as it makes itself felt. There is nothing better than champagne for stimulating the mind quickly and to its greatest brilliancy, and for this reason it is often prescribed by physicians; but, on the other hand, it is harmful in many physical conditions, particularly in all cases where the generation of carbonic acid is undesirable, as, for instance, in heart disease. The taste of champagne depends partly on the alcohol and sugar it contains and partly on the carbonic acid, which latter causes the agreeable tingling sensation on the tongue.

Champagne should be drunk cold, but never so that it cools the stomach or that its taste is lost. It is generally supposed to be best when cooled in ice so that it runs half frozen into the glass; but this is a great mistake, for then only the water freezes, and one drinks a mixture of crystals of ice and a sirup consisting of wine, alcohol and sugar. The condition that the French call "frappé" is reached by turning the bottle in ice for ten minutes; more than that is bad. Champagne that has been ordered for people with weak digestion, as a very effective dietetic remedy, should be only slightly cooled. Champagne is best when brought from a cold cellar, which may be provided with ice if necessary.

It is generally believed that when a bottle of champagne has been opened it must all be drunk at once, as any that is left will spoil. This also is a superstition. Special safety stoppers are now used after the original cork has been drawn, so that any quantity of the wine can be poured out without spoiling the remainder, which will have as much sparkle on the second or even the third day as on the first. Generally champagne is taken after the stronger wine, with the dessert—a custom which originated in France and spread from there. As soon as the cork is drawn conversation begins. Champagne is the wine of the toast, and is the only wine used for this purpose at banquets. Perhaps that accounts for its being called "king's wine," for at official dinners the first toast should be to the ruler of the land. But lately the custom has spread from England of serving champagne with all the courses to please the ladies, who prefer it to all other wines. In behalf of this custom it may be said that tongues and palates that have not been irritated by other wine can better appreciate the taste of the champagne, but, on the other hand, there is the important objection that the cold, and especially the cold acid, impairs the appetite, because it distends the stomach, straining its walls and decreasing its activity; at all events, it should be partaken of very sparingly during dinner. Champagne with meat a real epicure would consider barbarous; it is suitable only for oysters. It is much better with breakfast, luncheon, or a supper than with a substantial dinner. If anything must be taken with it, the best thing is light, but not sweet, cake. The champagne biscuit of Rheims are excellent and worthy of being taken with the chief product of the old coronation city. Many manufacturers of champagne send these biscuit gratis to their customers.

We are indebted to Der Stein der Weisen for the above article.

HOW AMERICAN APPLES ARE SOLD IN ENGLAND.

LIVERPOOL is by far the greatest point for distribution for American apples which reach English markets, says the Gardeners' Magazine. As many as one hundred thousand barrels have been sold in one week in that city at remunerative prices, so great is its power of absorption. Liverpool is the center of this apple trade, although London, Glasgow, and Hull at times also consume on an average twenty thousand to thirty thousand barrels per week, at figures fairly satisfactory to American shippers. The cost of delivering apples to the British market is not burdensome, the auction system employed reducing the charges to a very few. The ocean freight is 40 to 65 cents per barrel, much of the time close to 2s. The charges in Liverpool are about 7d. per barrel; these include dockage, town dues, insurance, advertising, sampling, and labor in handling; in addition is the 5 per cent. commission on sales. Supposing a parcel of Baldwins, for example, sells at 16s., 5 per cent. commission on this would be 19¼ cents, to which may be added 15 cents for petty expenses; total, a shade less than 1s. 7½d., representing the charges for selling a barrel of apples from Liverpool. Rates of ocean freight are often given at a certain figure, together with five per cent. "primage." When a freight rate is quoted at 2s. and 5 per cent., it means 2s. per barrel, adding 5 per cent. to this, or another 2½ cents, this addition being a continuance of an old custom when "primage" was an allowance made to the master of a vessel, either as a compensation for his services or for loading his cargo.

The place of auction consists of a room with seats arranged in semi-circular form, rising rapidly from the center. Persons sitting in seats in the rear can easily see what is going on at the desk. On the floor at the center of the rows of seats is a portable platform, which is really the floor of a freight elevator, rising from the basement, and on which the barreled samples of apples are displayed. The sample consists of two barrels from every lot of twenty or less. One barrel is simply opened on the "face" end, and the other is turned out in baskets before the audience of buyers. It will thus be seen that any dishonesty in packing will be detected at a glance. The buyer having made a purchase of a lot is allowed to take only those packages that are tight, or, as the local phrase goes, "are not slack." A "slack" is a barrel which rattles when shaken roughly. These sell from 2s. to 4s. below the price obtained in the auction room. The apple auctioneer has forty minutes at his command in which to dispose of his line of goods. If not all sold during that time he must stand aside temporarily while others take their turn. As soon as each of the half dozen salesmen has had his turn of forty minutes, the routine is repeated, continuing until all the goods on the market for that day are disposed of. Sometimes an auction sale of apples is not completed until midnight. Buyers are obliged to take twenty barrels at least on every accepted bid, with the option of as many more of the given brand as desired.

Apples are catalogued according to the shipping marks and variety. Where there are only two or three packages under a given mark, several of these small lots are grouped together for convenience in lots of twenty barrels each. Many brands are sold almost wholly on their reputation of honest package and uniformity of soundness. Deliveries are made direct from the steamer dock, which saves cartage freight. There are three sale days each week at Liverpool, Monday, Wednesday, and Friday. A single auctioneer has been known to sell more than 15,000 barrels of apples in one day.

THE FORMATION OF BLOOD FROM INORGANIC IRON.

OF the few physiological chemists in this country, none stand higher at home and abroad than Chittendon, who, in the Dietetic and Hygienic Gazette for November, 1895, states editorially that hardly any one question in physiological chemistry has provoked more discussion than that suggested by the above title. Will the iron contained in ordinary inorganic preparations be absorbed from the intestine, and can it be utilized in the formation of hemoglobin? The question has been asked many times in the past, and the answer is at least implied in the fact that in older handbooks of therapeutics the inorganic preparations of iron constitute the sole remedies in chlorosis. Of late, however, there has been a growing conviction that, in the formation of hemoglobin within the body, only organic iron compounds can be utilized—such, for example, as are found in the ordinary foodstuffs.

That inorganic iron compounds can be absorbed from the intestine, at least to a certain extent, is seemingly proved by the experiments of Professor Kunkel, of Wurzburg, and his results have been recently confirmed by Woltering, of Utrecht, who also claims that the absorbed iron is built up into peculiar organic compounds in the liver. Kunkel, who has taken up the subject anew, considers that there are two questions which need to be definitely settled before we can positively assert that the organism is able to build up hemoglobin out of inorganic iron.

A normally nourished mammal contains in its liver a certain store of organic iron compounds which unquestionably serve as a reserve material for the more or less continuous formation of blood going on in the body; and especially to supply the needs of the system whenever there arises any necessity for increase in the production of hemoglobin, as after loss of blood by bleeding, etc. This being so, we need to know whether the iron compounds found in the liver in increased amount after feeding with iron salts are identical with this normal reserve material. Secondly, is hemoglobin actually formed out of the iron compounds which result from the absorption of inorganic iron salts from the intestine?

These questions Kunkel has attempted to answer in the following manner: An animal was fed with an abundance of nourishing food containing all the elements necessary for the needs of the body, being deficient only in iron, and every week a quantity of blood was withdrawn sufficient to materially change the composition of the blood but not to endanger life nor interfere with functional power. The iron withdrawn after this manner with the blood was determined by chemical analysis. Pursuing such a method, it is easy to withdraw from the animal more iron than it can absorb from the food, thus rendering the body poor in iron and the blood poor in hemoglobin. Now if, with such an animal, the feeding of inorganic salts results in the blood becoming normal again in its content of iron, it follows that the hemoglobin must be formed, indirectly at least, from the inorganic iron.

The food used in the experiments was exclusively cow's milk, which contains on an average only one milligramme of metallic iron per liter. The animals were two young dogs of the same litter, and with a body weight of 2,000 and 2,300 grammes respectively. They were fed daily on 750 grammes of milk, on which they flourished and gained fat. Dog B received only the milk, while dog A was given daily in addition thirty drops of a solution of albuminate of iron, equivalent to 4·4 milligrammes of metallic iron. The experiment was continued through seven weeks, each animal being depleted of about one-third of its blood every week. In this way, at the end of the seven weeks each animal had lost about two and a half times as much blood as it possessed at the beginning of the experiment. The following abbreviated table gives a résumé of the results obtained from the analysis of the blood of the two animals:

DOG A, WITH IRON.

	Blood withdrawn.	Fe_2O_3 in the Blood.
First week	44·2 Gm.	0·0215 Gm.
Second week	45·9	0·0178
Third week	54·3	0·0192
Fourth week	58·1	0·0194
Fifth week	53·3	0·0194
Sixth week	59·6	0·0229
Seventh week	39·6	0·0138
	355·0	0·1340

Iron taken in six weeks..... 0·30870 Gm. Fe_2O_3.
Iron taken in seven weeks...0·36015 Gm. Fe_2O_3.

DOG B, WITHOUT IRON.

	Blood withdrawn.	Fe_2O_3 in the Blood.
First week	50·6 Gm.	0·0227 Gm.
Second week	54·2	0·0273
Third week	56·0	0·0145
Fourth week	63·3	0 0192
Fifth week	54·3	0·0127
Sixth week	51·0	0·0116
Seventh week	21·5	0·0042
	350·9	0·1122

Iron taken in six weeks.....0·04410 Gm. Fe_2O_3.
Iron taken in seven weeks...0·05145 Gm. Fe_2O_3.

From these results it is seen that dog B lost in the blood withdrawn 112 milligrammes of ferric oxide, while in the food consumed during the period there was contained only 44 milligrammes of ferric oxide. In this animal anemia was very marked. Dog A, on the other hand, which had lost somewhat more blood, containing in all 134 milligrammes of ferric oxide, showed no signs of anemia, a result which can be explained only on the assumption that the animal had absorbed a portion of the iron of the albuminate and utilized it for the production of new blood. This supposition is made still more probable by the following facts: One week after the withdrawal of the last portion of blood, both dogs were killed by ether and all the organs freed from blood by injecting through the aorta 0·8 per cent. salt solution until the fluid came through colorless. While, obviously, all the blood cannot be removed in this manner, full 70 per cent. can be obtained. The blood and washings were then united and the content of iron determined, and the more important organs were likewise analyzed for iron, with the following results:

DOG A, WITH IRON.

Weight of the animal, 3,150 Gm.

	Fe_2O_3
The blood contained	0·0404 Gm.
The liver contained	0·0317
The spleen contained	0·0043
The kidneys contained	0·0025
The ribs contained	0·0011

DOG B, WITHOUT IRON.

Weight of the animal, 3,300 Gm.

	Fe_2O_3
The blood contained	0·0252 Gm.
The liver contained	0·0043
The spleen contained	0·0013
The kidneys contained	0·0014
The ribs contained	0·0001

These data, showing as they do such a marked difference in the amount of iron in the tissues of the two animals, are explainable only on the assumption that the dog, A, had absorbed a certain amount of the iron preparation given him with the food, utilizing it for the production of new hemoglobin.

Especially noteworthy is the comparatively large amount of iron found in the liver of the dog fed with the iron albuminate. It would seem to be plain that the liver has the power of picking up and retaining within its tissue a certain amount of iron which is destined to serve as a store of this material to aid in the manufacture of new blood whenever it is needed by the body. This view, indeed, is in close harmony with many facts—such, for example, as the liability to severe anemia after diseases of the liver.

Further, in the examination of the ribs of the two animals, the red medullary matter only being examined, it is to be noted that even macroscopically there was a wide difference in their appearance. Thus, in the dog, A, the medulla had the characteristic red color, while in the dog, B, it was only faintly colored—a difference which is quite in harmony with the content of iron found on analysis.

Without considering the results more in detail, it is plain that Kunkel has given us some very interesting data, which seemingly verify the ability of the system to utilize such compounds as the albuminate of iron for the manufacture of hemoglobin and the production of new blood.

There is another matter brought out experimentally in these results, which is perhaps worthy of a moment's consideration, viz., the wonderful power of reconstruction possessed by the system. Thus, the dog, B, in the first four bleedings lost 214 grammes of blood. Now, originally, before the animal was bled at all, the total amount of blood in the body could not have amounted to more than 170 grammes; hence, in these three to four weeks there must have been a reconstruction of blood amounting to a quantity considerably in excess of the whole volume present in the body at the beginning of the experiment. Yet the animal was able to accomplish all this in a short period of time without any noticeable deterioration or strain upon the system.

Whether inorganic iron is as readily utilized by the body in the production of hemoglobin as organic iron, such as ferruginous nucleo-albumens, hematogen, etc., is a question not considered in Kunkel's work, but

plainly the animal body can make use of inorganic iron in the absence of any more favorable material to work with.—The Therapeutic Gazette.

A CENTURY OF VACCINATION.

As briefly summed up in a recent number of the British Medical Journal, the results of vaccination during the century of its practice are very striking. It was on May 14, 1796, that Jenner performed his first successful vaccination. The average mortality from smallpox in Europe during the century preceding vaccination was, in the cities alone, 3,000 per 1,000,000 inhabitants; including the country parts, it was somewhat over 2,000 per 1,000,000 inhabitants. Owing to frequent epidemics of smallpox, the mortality rose occasionally to between 5,000 and 6,000 per 1,000,000 inhabitants. In the century since vaccination, the mortality from smallpox has not been one-tenth of that figure, as we shall see by taking statistics from individual countries.

In England the mortality rate was over 2,000 per 1,000,000 in the last century; during permissive vaccination the rate fell to 417 per 1,000,000, and during compulsory vaccination from 1871, the mean rate has fallen to 53. The distance from a mean ante-vaccination mortality rate of 2,000 to a mean compulsory vaccination rate of 53 is a long distance.

In Sweden, the quarter century preceding vaccination the mean mortality rate from smallpox was 2,045 per 1,000,000 inhabitants. During the fifteen years, 1802–16, of permissive vaccination, the rate fell to 480; and during seventy-seven years (1817–94) of compulsory vaccination, it fell to 155. This is not as good a result as in England; but still it is a material tumble from the ante-vaccination death rate of 2,045 per 1,000,000 inhabitants to the compulsory vaccination death rate of 155!

Prussia furnishes the finest example of immunity from smallpox through rigorous vaccination. Her ante-vaccination mean death rate from smallpox was over 2,000; during the permissive period it fell to 309; and during the compulsory period, since 1874, the mean rate has been only 15 per 1,000,000 inhabitants! Italy, during the permissive period, had a mean death rate from smallpox of 440; during the later compulsory period the rate has fallen to 110. Austria and Belgium practice vaccination, not by compulsion; and in the former the mean rate is 580, and in the latter 441. Spain does not practice vaccination generally, and her death rate from smallpox in the single year 1889 was in these provinces: Almeria, 3,080; Murcia, 2,670; Corunna, 1,230; Malaga, 1,340; Cadiz, 1,330; Cordova, 1,490. In Germany that same year the death rate from smallpox was 4.

BECQUEREL RAYS.

By A. F. MCKISSICK.*

SOME time ago Becquerel discovered that certain uranium compounds emitted, after exposure to sunlight, radiations which, like the Roentgen rays, could pass through plates of aluminum or cardboard, and effect a photographic plate behind, and also that this radiation could be polarized or refracted. He found that the potassium platinum compound of uranium emitted these rays for fifteen days, after it had been first exposed to sunlight.

It occurred to me that probably a great many of the fluorescent and phosphorescent substances would give radiations of this kind, and with this idea I tried all such substances that are known as available, and found that the following gave these radiations, viz., lithium chloride in solution, barium sulphide, calcium sulphate, quinine chloride, quinine sulphate, calcium nitrate, sugar, chalk, glucose, sodium tungstate, sterein, uranium acetate and ammonium phospho-molybdate.

In making the experiment, the articles to be photographed were placed in contact with the sensitive plate in the plate holder, the cover put on and the substance, after an exposure to direct sunlight for two hours, sprinkled over the cover of the plate holder. The plate holder was then carefully covered with a dark cloth to prevent light from reaching it.

The time of exposure necessary to give a clear photograph was found to be from 48 to 72 hours, varying with different substances. A slow plate (sensitometer No. 16) was used with ordinary developer and fixing bath.

The negatives obtained were rather weak, but showed clearly that the light was very much like the Roentgen rays, inasmuch as both glass and metal were opaque to the light, while cardboard and wood were transparent.

A very peculiar property noticed was that generally more than one image of an object was produced, although the object was in direct contact with the sensitive plate. In one negative there are four images of one half dollar, in another two images of a key, the images being at right angles to each other. One of the images was always much clearer than the others. I have noticed on several negatives two images of an object near one edge of the negative and near the opposite edge only one image of an object, so that this action, whatever it is, was not uniform.

Of all the substances tried I found granulated sugar to be the best. I have succeeded in taking a fairly clear negative through 2½ inches of wood with sugar.

Prof. B. B. Ross suggested that inasmuch as quite a number of fluorescent and phosphorescent substances possessed high molecular weights, other substances of high molecular weight, although not previously known to be either fluorescent or phosphorescent, might give off these rays. With this idea sterein and ammonium-phospho-molybdate were tried. The first, sterein, darkened the sensitive plate only slightly, but the last one, ammonium-phospho-molybdate, gave a fairly good negative, on which were observed two images of one object.

Uranium nitrate, sprinkled on top of the plate holder containing the sensitive plate and then exposed to sunlight for eighteen hours, gave only a faint negative.

FOUR 32 knot torpedo boat destroyers are being constructed for the Chinese Government by the Schichau works at Elbing, in Germany. They will have engines of 6,000 horse power and must be finished within thirteen months.

* From the Electrical World.

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